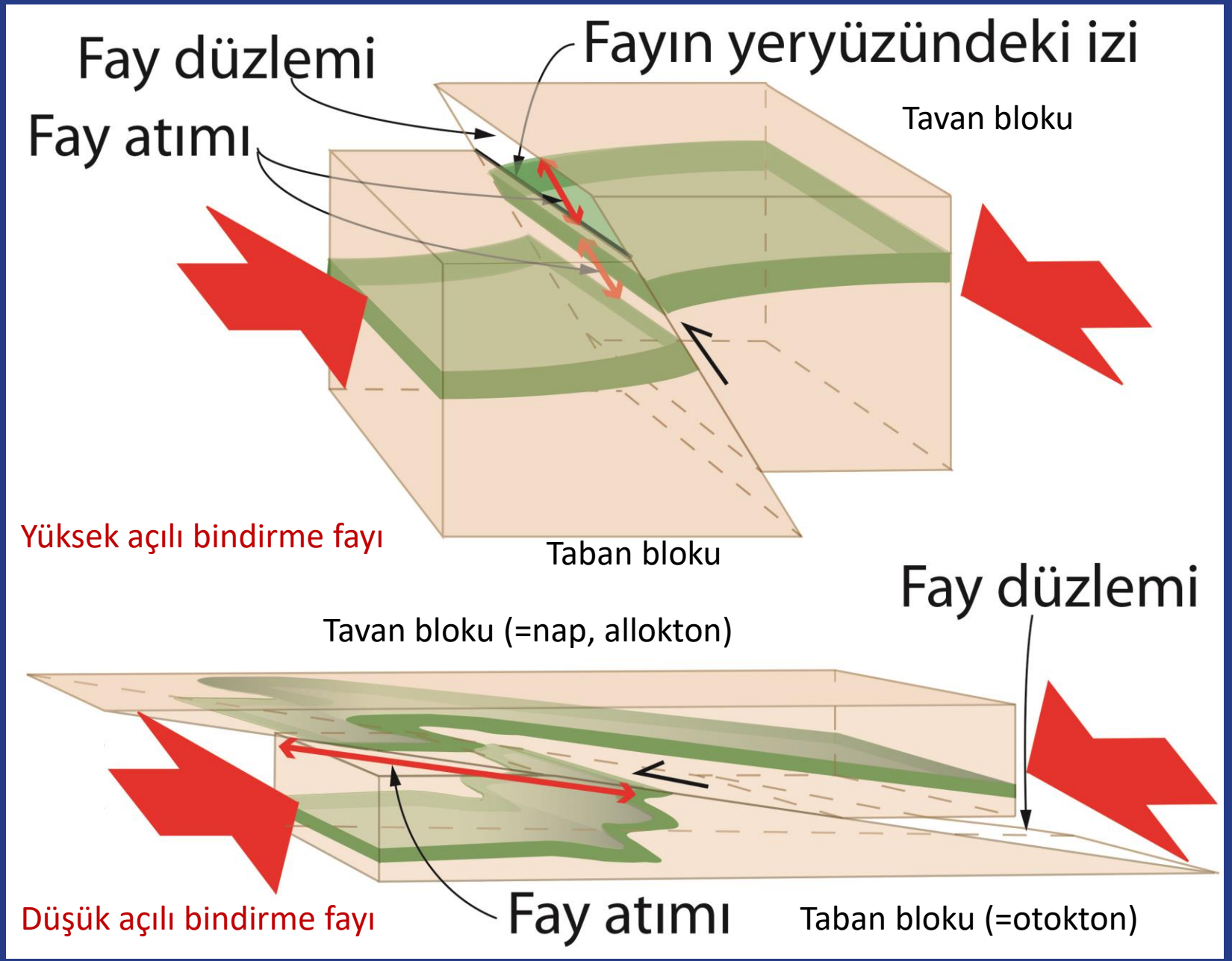
BİNDİRME FAYLARI VE SÜRÜKLENİMLER

A. M. Celâl Şengör


Fay düzlemi
Fayın yeryüzündeki izi
Fay atımı
Tavan bloku
Yüksek açılı bindirme fayı
Taban bloku
Fay düzlemi
Tavan bloku (=nap, allokton)
Düşük açılı bindirme fayı
Fay atımı
Taban bloku (=otokton)

Allokton: başka yerden gelme, olduğu yere yabancı

Allokton şu iki Yunanca kelimeden türetilmiştir:

ἄλλος (*allos*= diğer)

χθών (*kton*= yer)

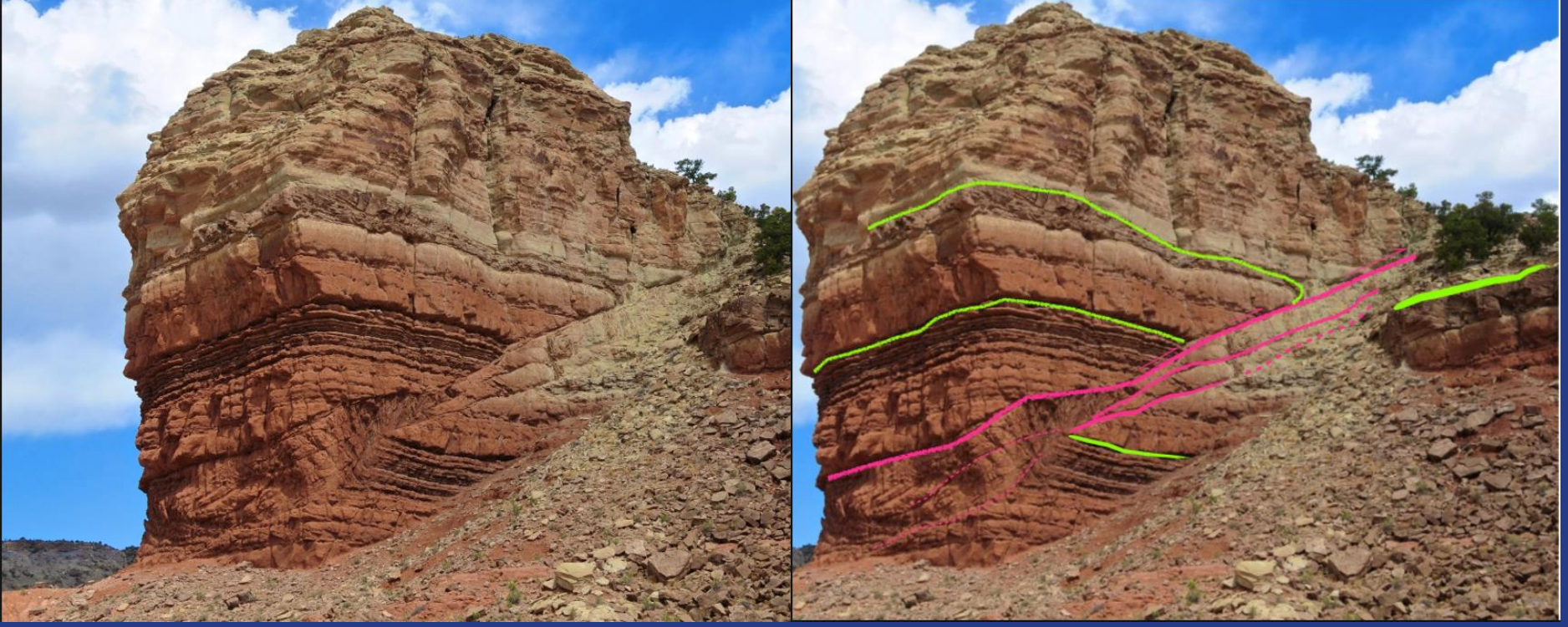
Otokton: olduğu yere ait

Otokton şu iki Yunanca kelimeden türetilmiştir:

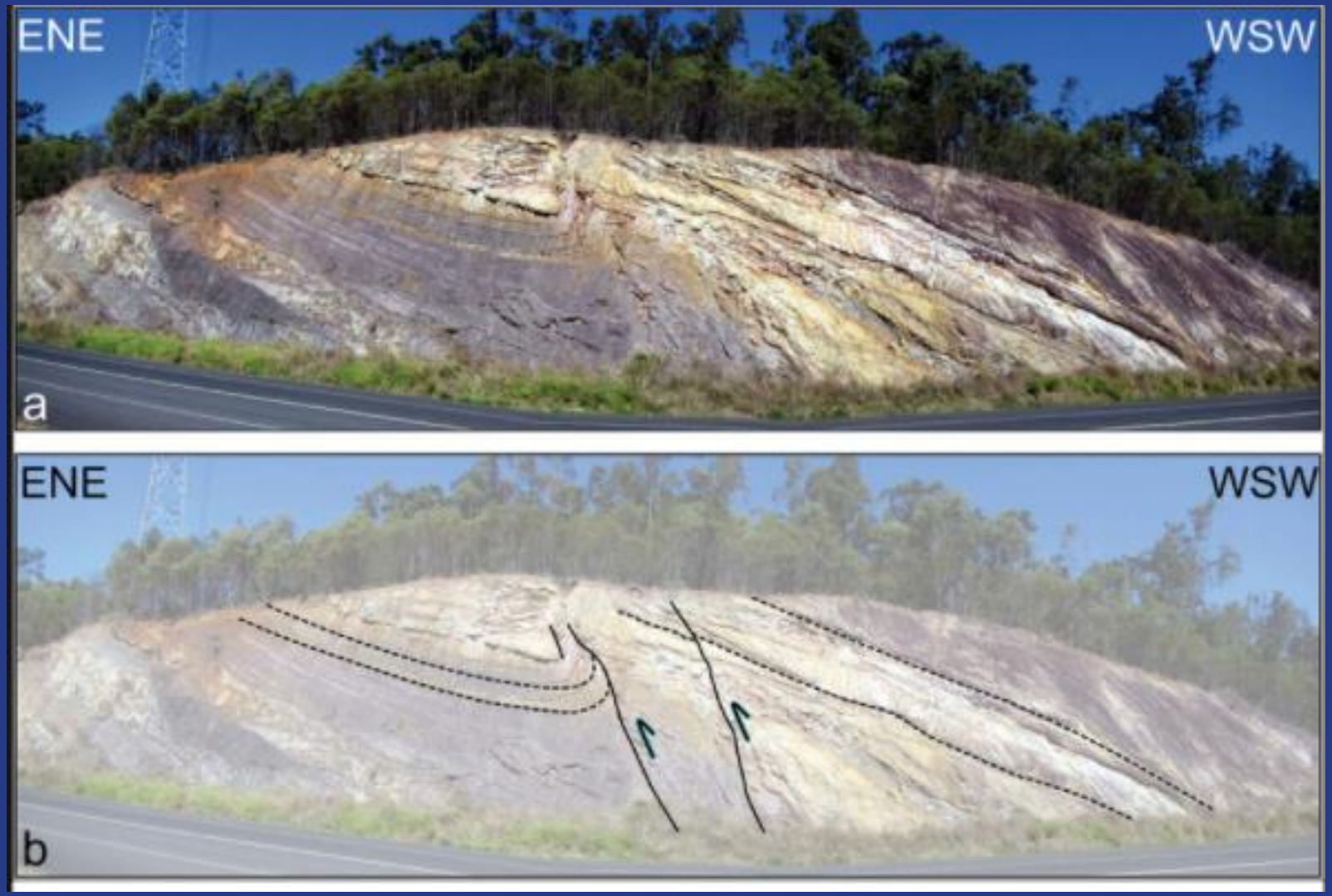
αὐτός (*autos*=kendi, aynı)

χθών (*kton*= yer)

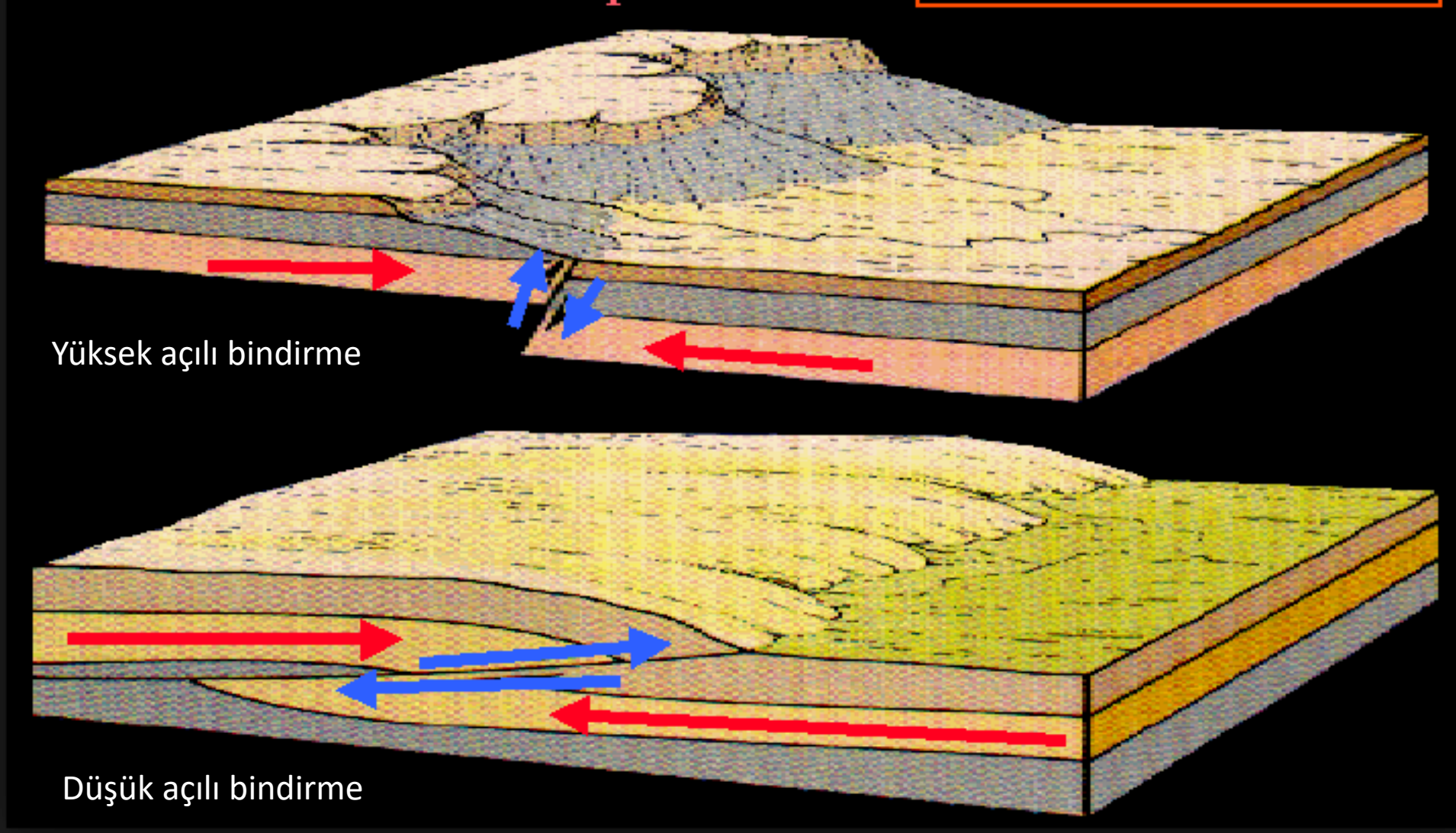
Yüksek açılı bindirme fayı, Utah, ABD



Yüksek açılı bindirme fayı, Utah, ABD



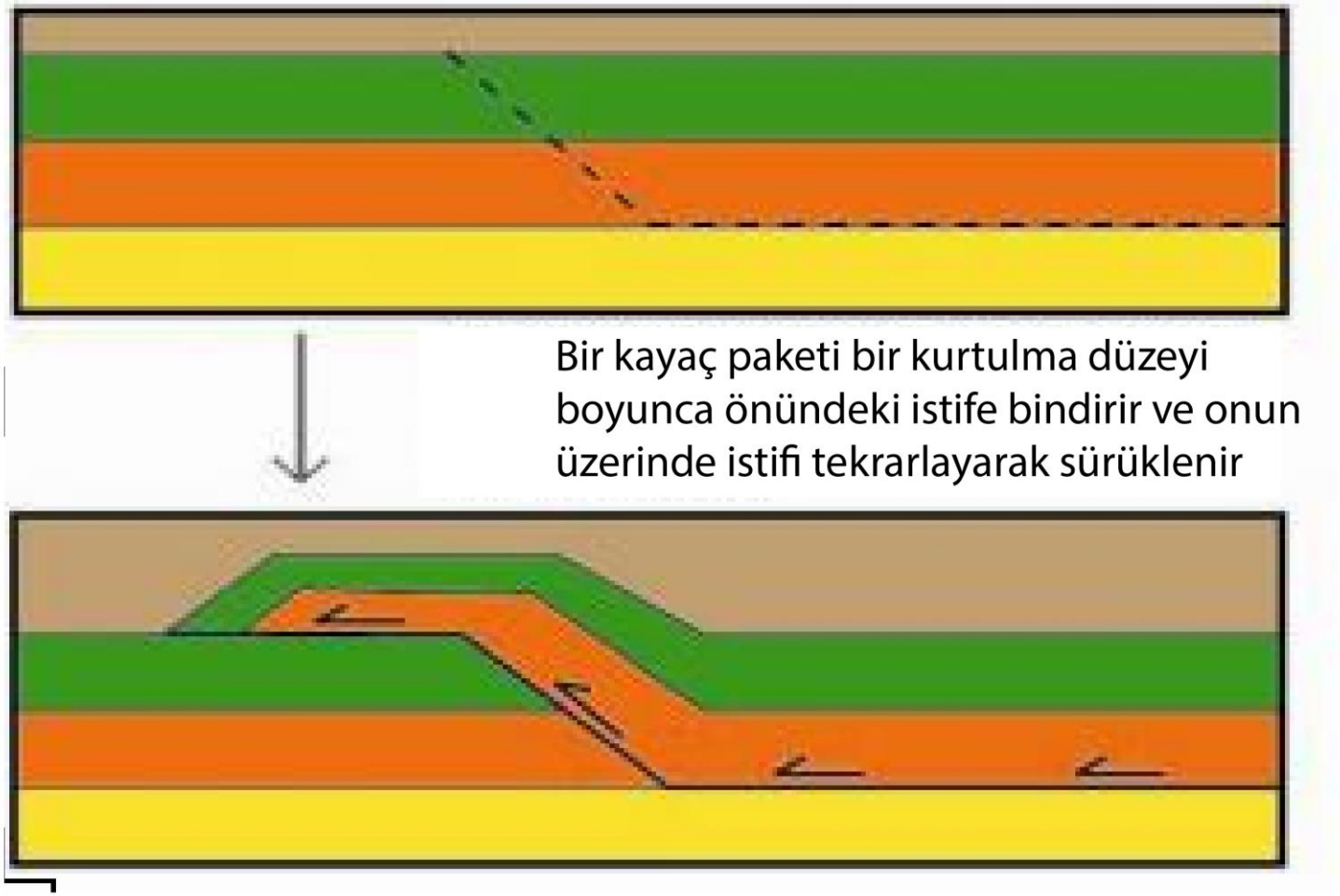
Yüksek açılı bindirmeler: Clarence-Moreton Havzası, Avustralya



Yüksek ve düşük açılı bindirmelerin yeryüzündeki muhtemel ifadeleri (aşınmadan sonra!)

Birinci tür nap (*nappe du premier genre*: Pierre Termier, 1911)

Bindirme napı (=sürüklenim)



İkinci tür nap (nappe du deuxième genre: Pierre Termier, 1911)

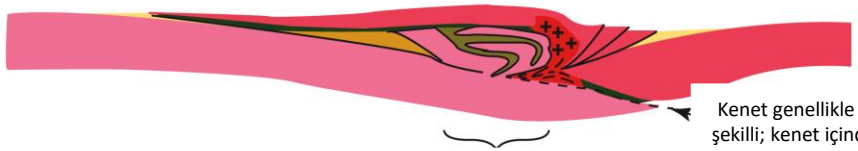
Birinci ve ikinci tür naplar arasındaki farklılığın temel nedenleri nedir?

1. Oluştukları ortamın ısıl durumu: sıcak: birinci tür nap; soğuk ikinci tür nap

2. Oluştukları ortamın basınç durumu: yüksek basınç: birinci tür nap; alçak basınç ikinci tür nap

3. Oluşma hızları: yavaş: birinci tür nap; hızlı ikinci tür nap

Örten nap kıt'asal

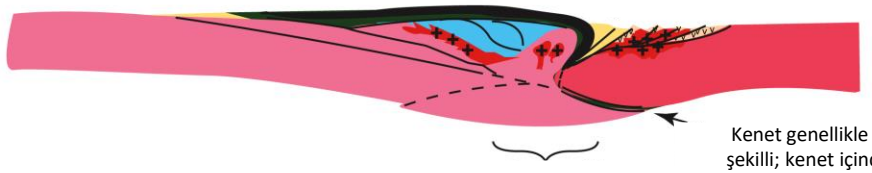


Kenet genellikle Z şekilli; kenet içinde okyanusal malzeme nadir

Metamorfik çekirdek genellikle derin deniz kayaçları içerir

Üstü örtülü tip

Örten nap okyanusal



Kenet genellikle C şekilli; kenet içinde okyanusal malzeme bol

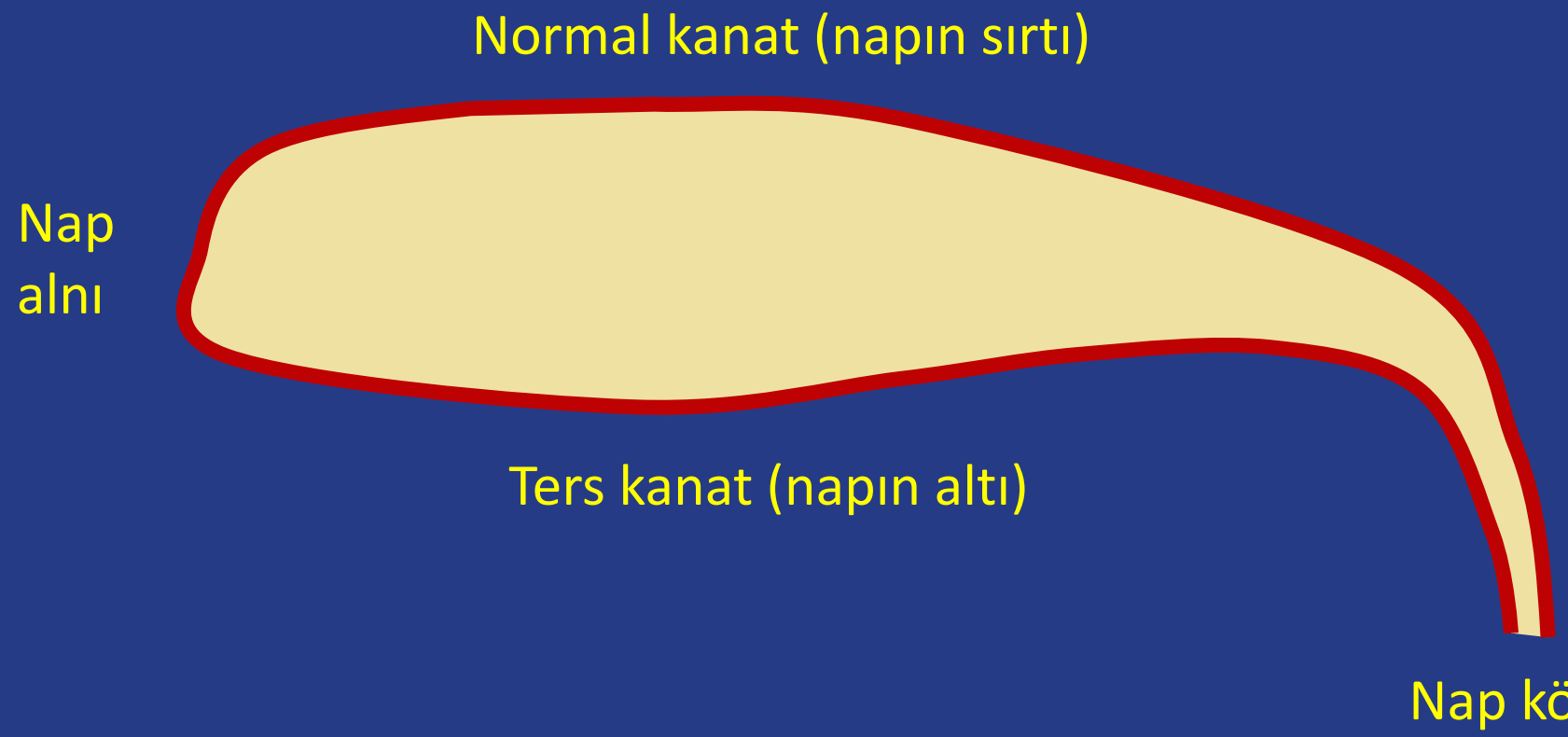
Metamorfik çekirdek genellikle kıt'a sahanlığı ve yamacı kayaçlarını içerir

Örten nap yok

Üstü açık tipler

- Molas
- Fliş
- Yığışm karmaşıkları
- Ofiyolit
- Kıt'a temeli
- Felsik ve ortaç volkanitler
- Felsik ve ortaç plutonitler

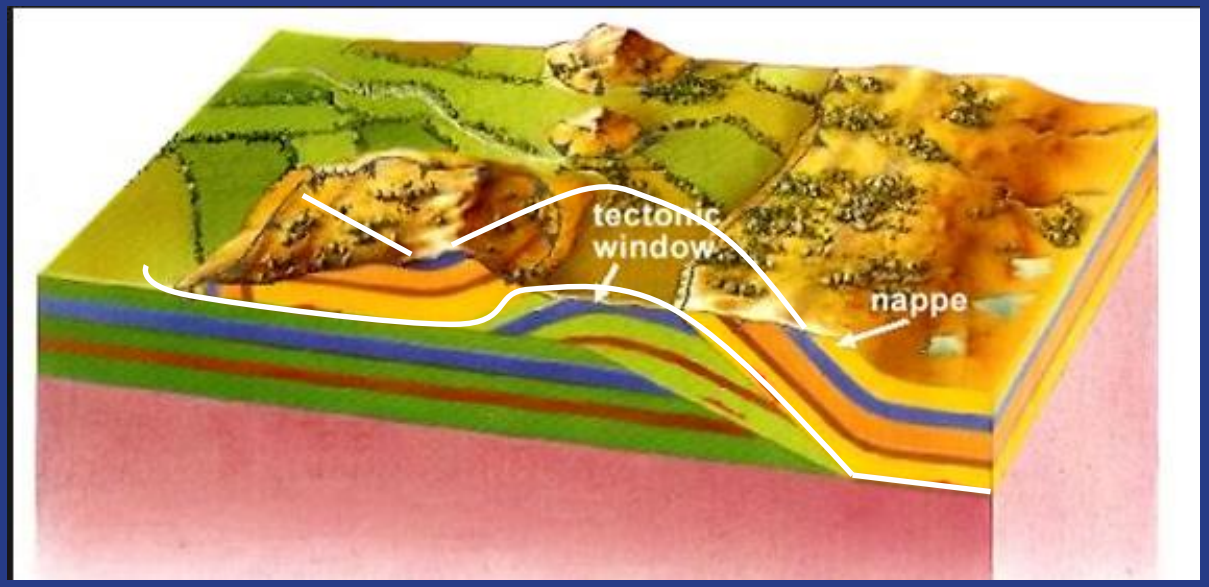
Birinci tür nap (*nappe du premier genre*: Pierre Termier, 1911)

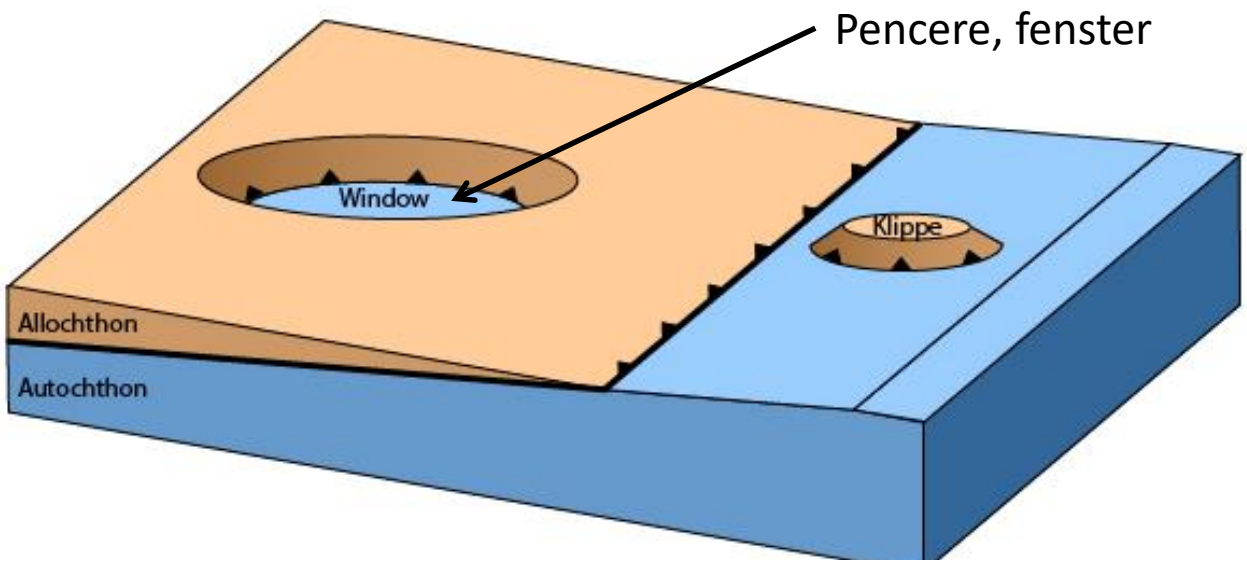


Birinci tür napların basitleştirilmiş terminolojisi

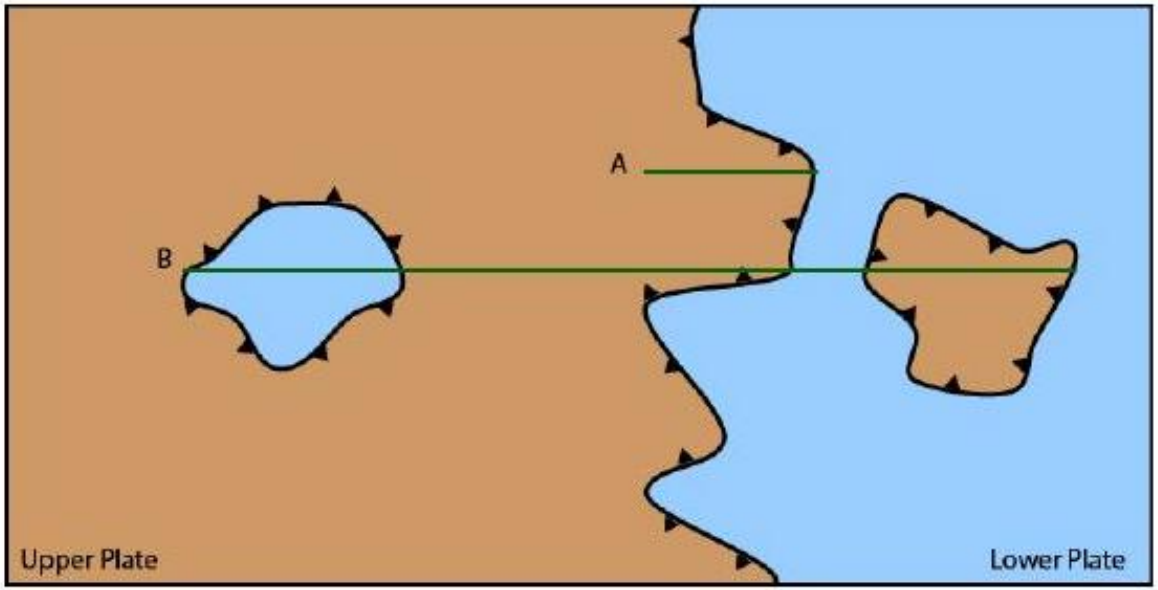
Klip

Pencere



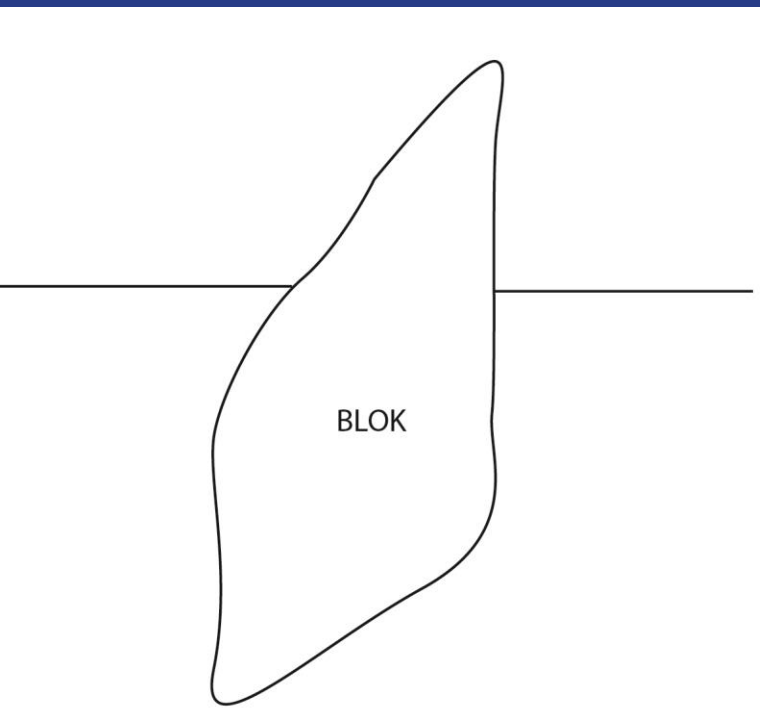


Thrust Front Bindirme cephesi, şaryaj cephesi



A: Pencere ve klip olmasaydı ölçebileceğimiz minimum bindirme atımı

B: Pencere ve klip sayesinde ölçebileceğimiz minimum bindirme atımı



MATRİKS

KARPAT TİPİ KLİP

OTOKTON TEMEL

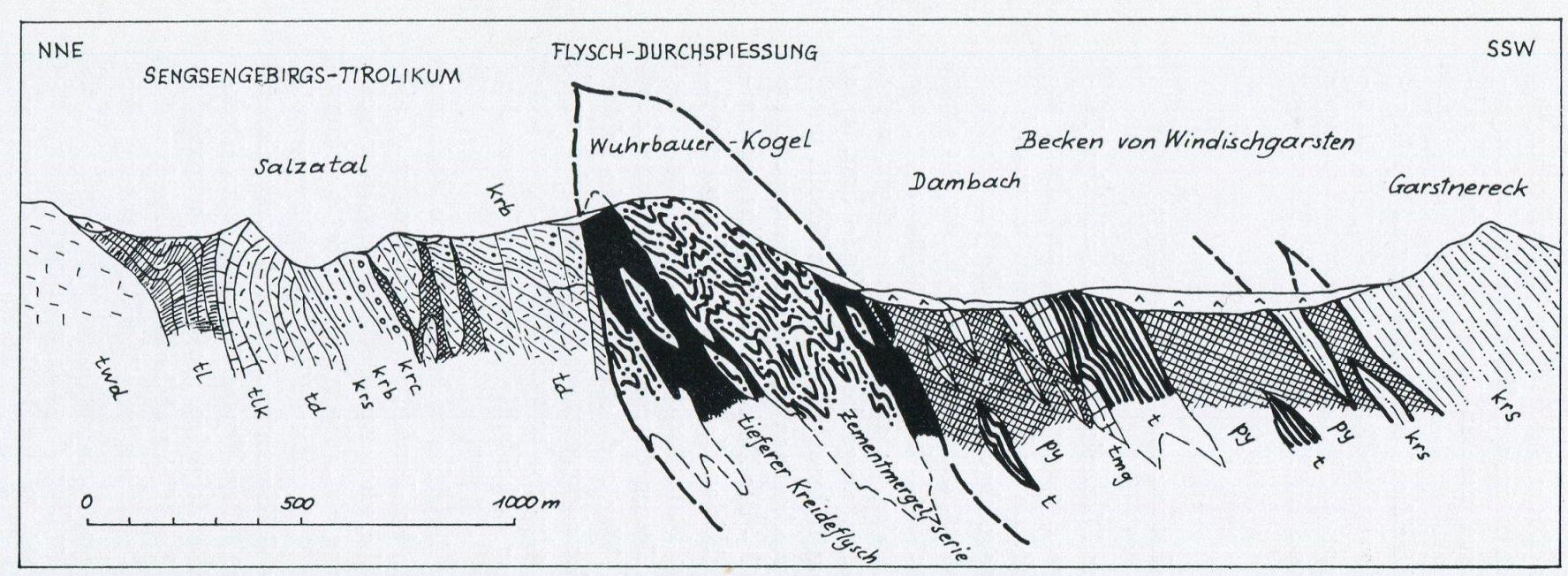
İSVİÇRE TİPİ KLİP

İki tür klip:

Karpat tipi klip: Bir matriks içerisindeki blokların yeryüzündeki görünüşleri

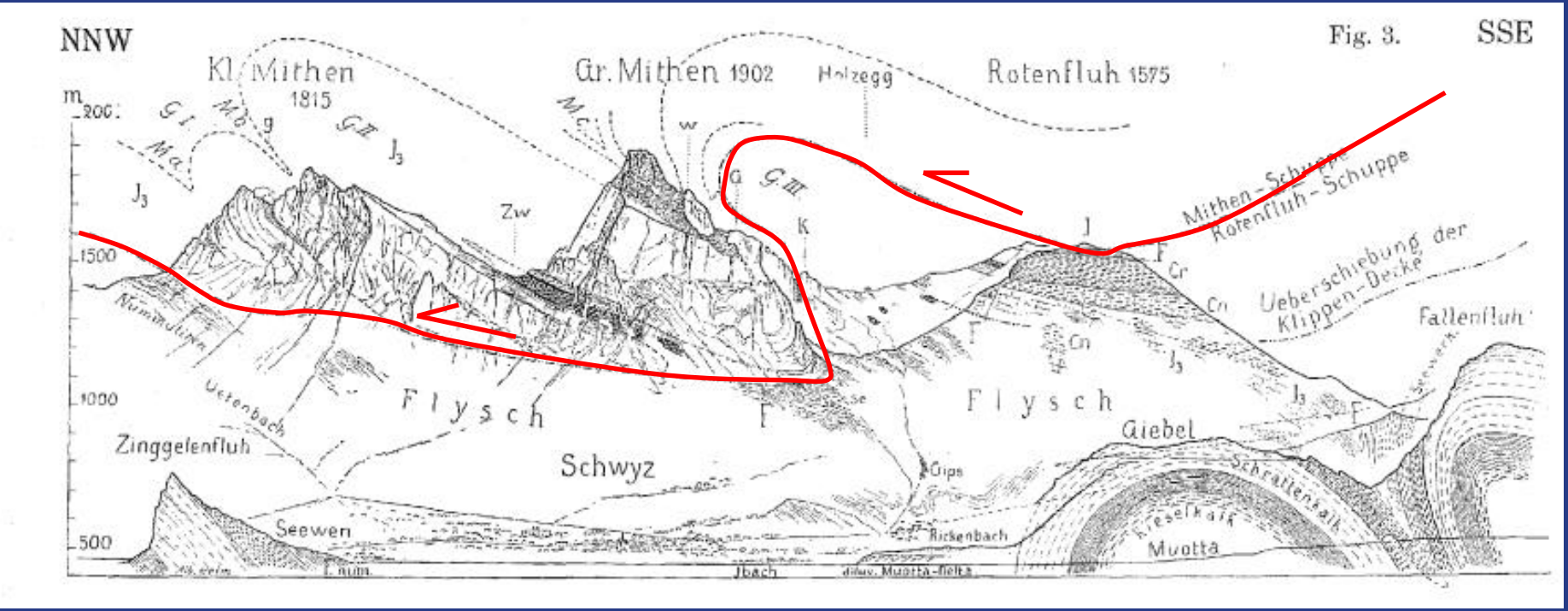
İsviçre tipi klip: Aşınmış bir napın parçası

Karpat tipi bir klip: Vršatec Klipi



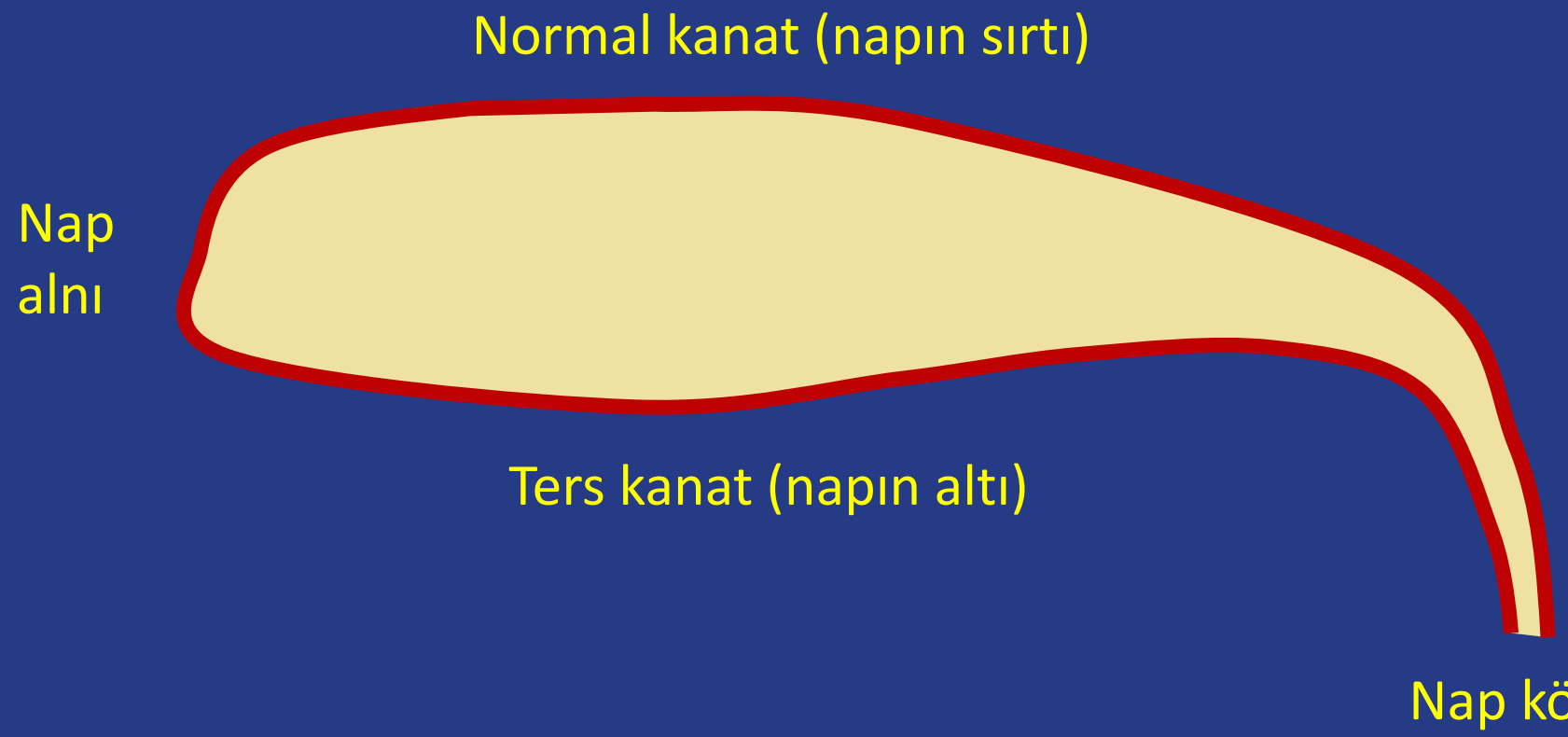
Karpat tipi bir klip. Avusturya Alpleri

Isviçre tipi bir klip: Mythen klipleri: Büyük ve Küçük Mythen



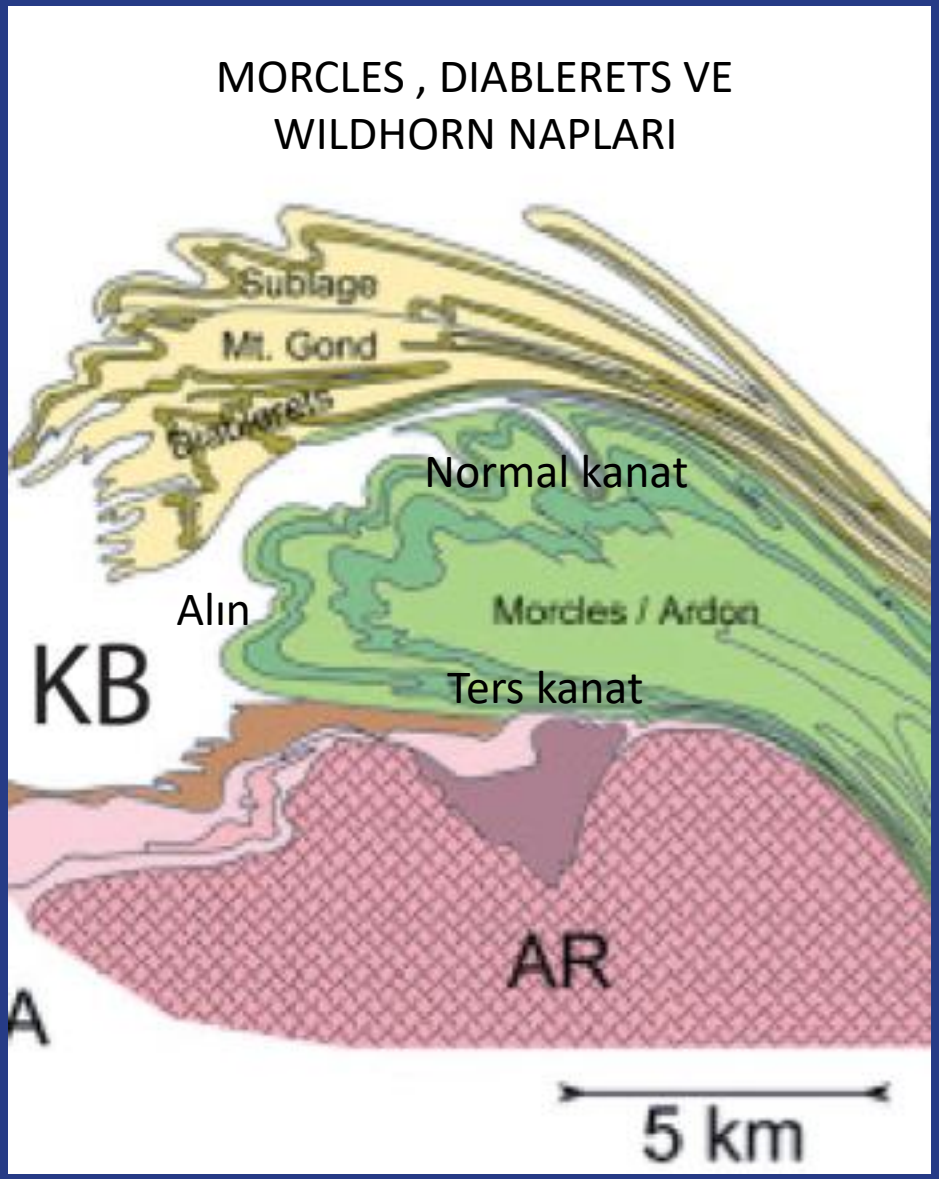
Mythen Klipi, İsviçre Alpleri

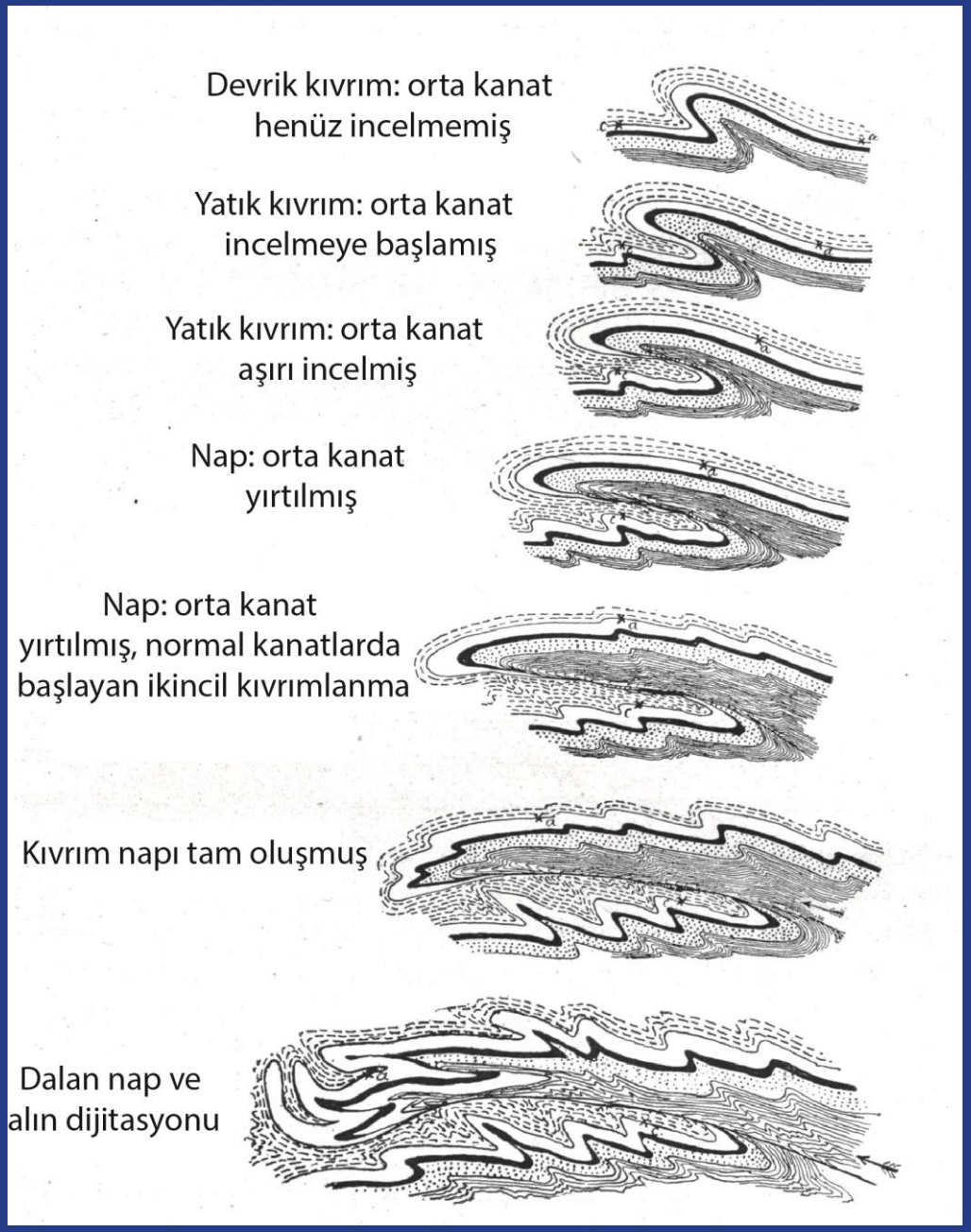
Binderme fayının kendisinin de kıvrımlanmış lduğuna dikkat ediniz



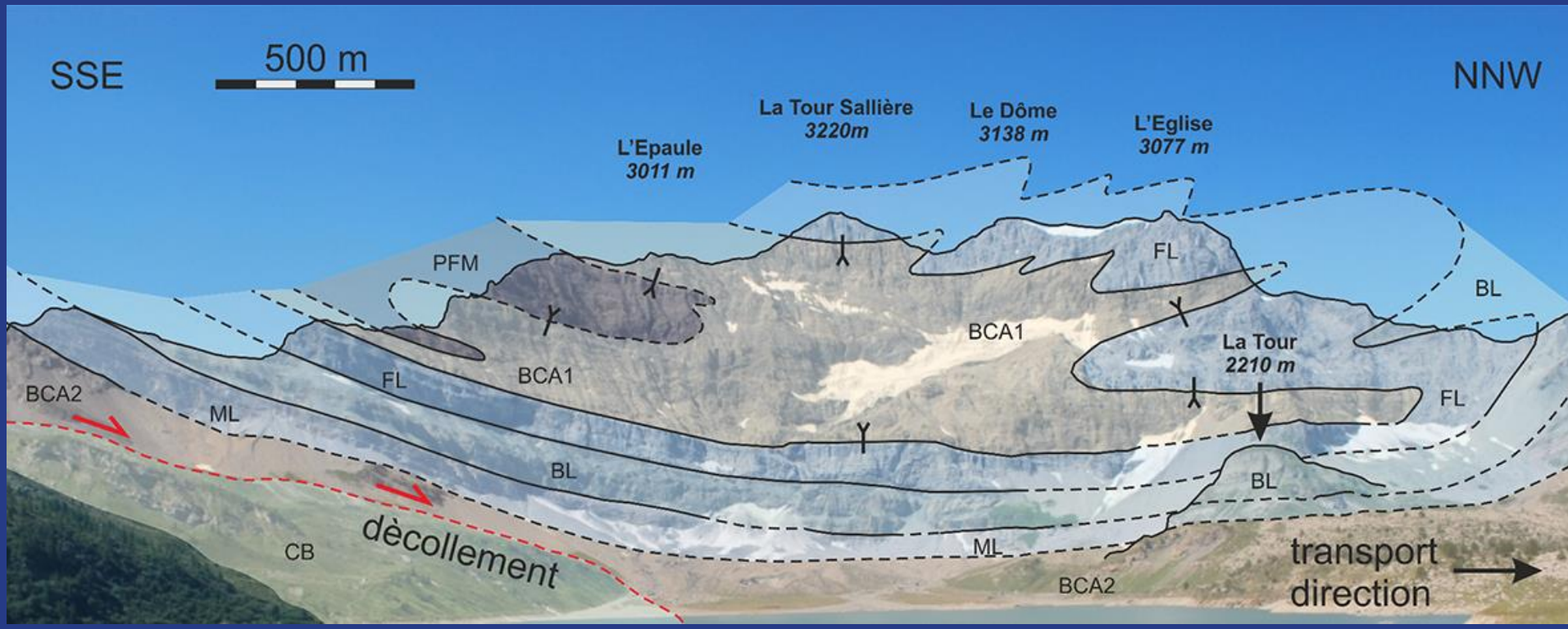
Birinci tür napların basitleştirilmiş terminolojisi

MORCLES , DIABLERETS VE
WILDHORN NAPLARI



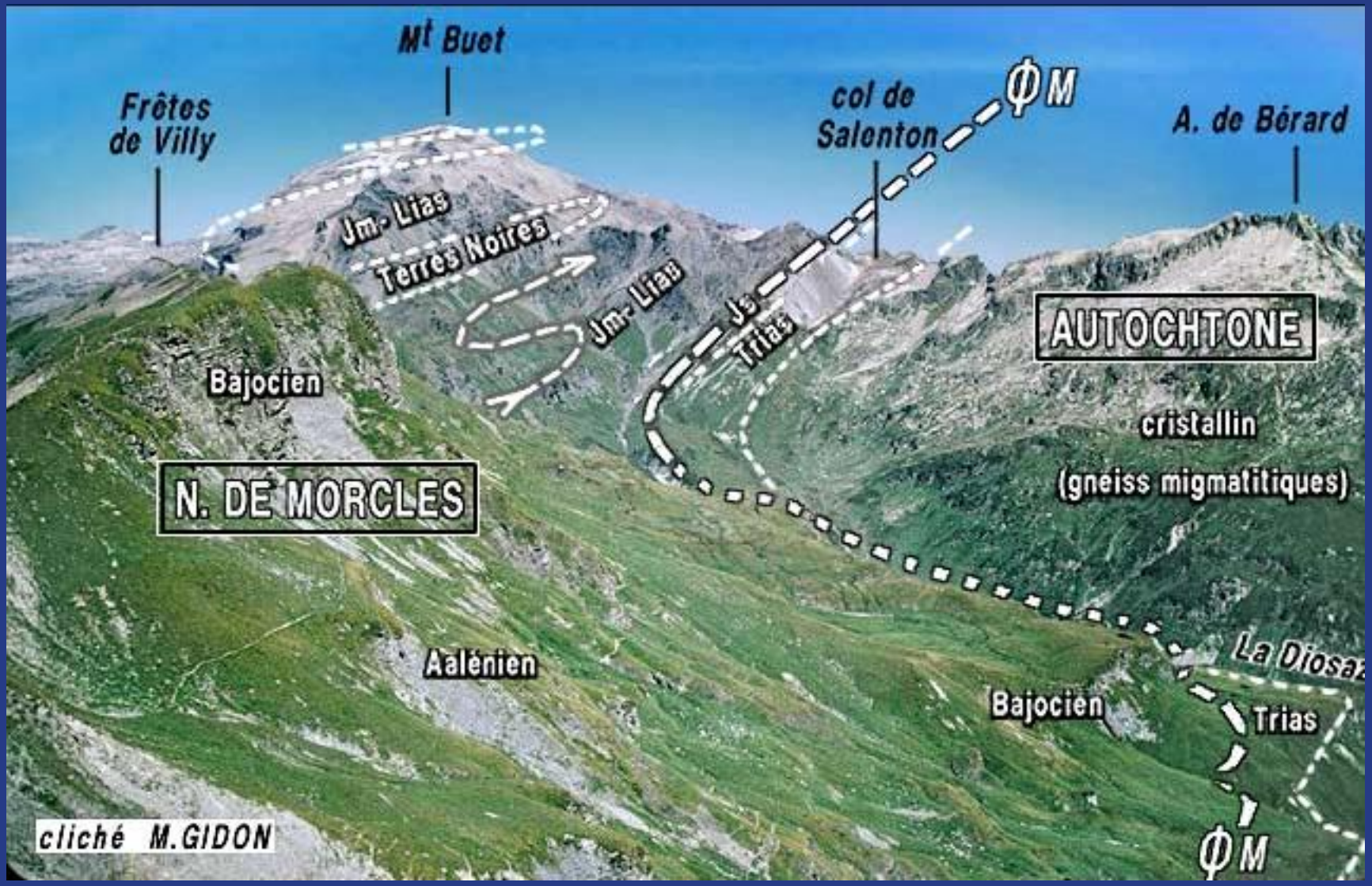


Birinci tür bir napın muhtemel gelişimi (Heim, 1921)



Morcles Napının yatık kıvrımları ve taban kurtulması. Salanfe Gölü kenarı, Batı Alper, İsviçre (Foto: Andy Cross).

Morcles Napı taban kurtulma düzeyinin manzarası: Salenton Geçidi ve çevresi, Chamonix yakınları, Batı Alpler, Fransa



Salenton Geçidi çevresinin jeolojisi

Batı Alplerdeki napların çoğu dev yatık benzer kıvrımlar şeklindedirler

Batı Kesimi

Doğu Kesimi

KB

GD

Sublage

Mt. Gond

Diablerets

Morcles / Ardon

Wildhorn

Jägerchürz

Doldenhorn

Gellihorn / Plammis

Ga

Aar

B

B'

5 km

KB

GD

AR

MB

A

A'

5 km

AR Aiguilles Rouges Masifi
MB Mont Blanc Masifi
Ga Gastern Masifi
Aar Aar Masifi

Rawil alçalımı

3 boyutlu geometri

B

KB

Aar

B'

A

AR

GB

A'

Subalpin (=Alp "altı") flişi

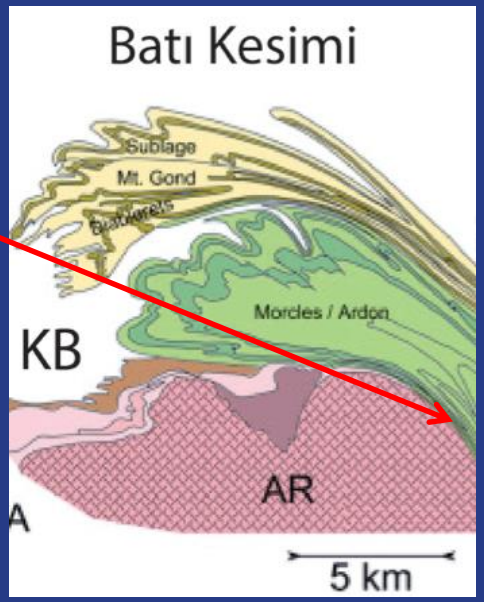
Ultrahelvetikler (=Helvetik üstü birlikleri)

Diablerets/Mt. Gond/Sublage)Wildhorn

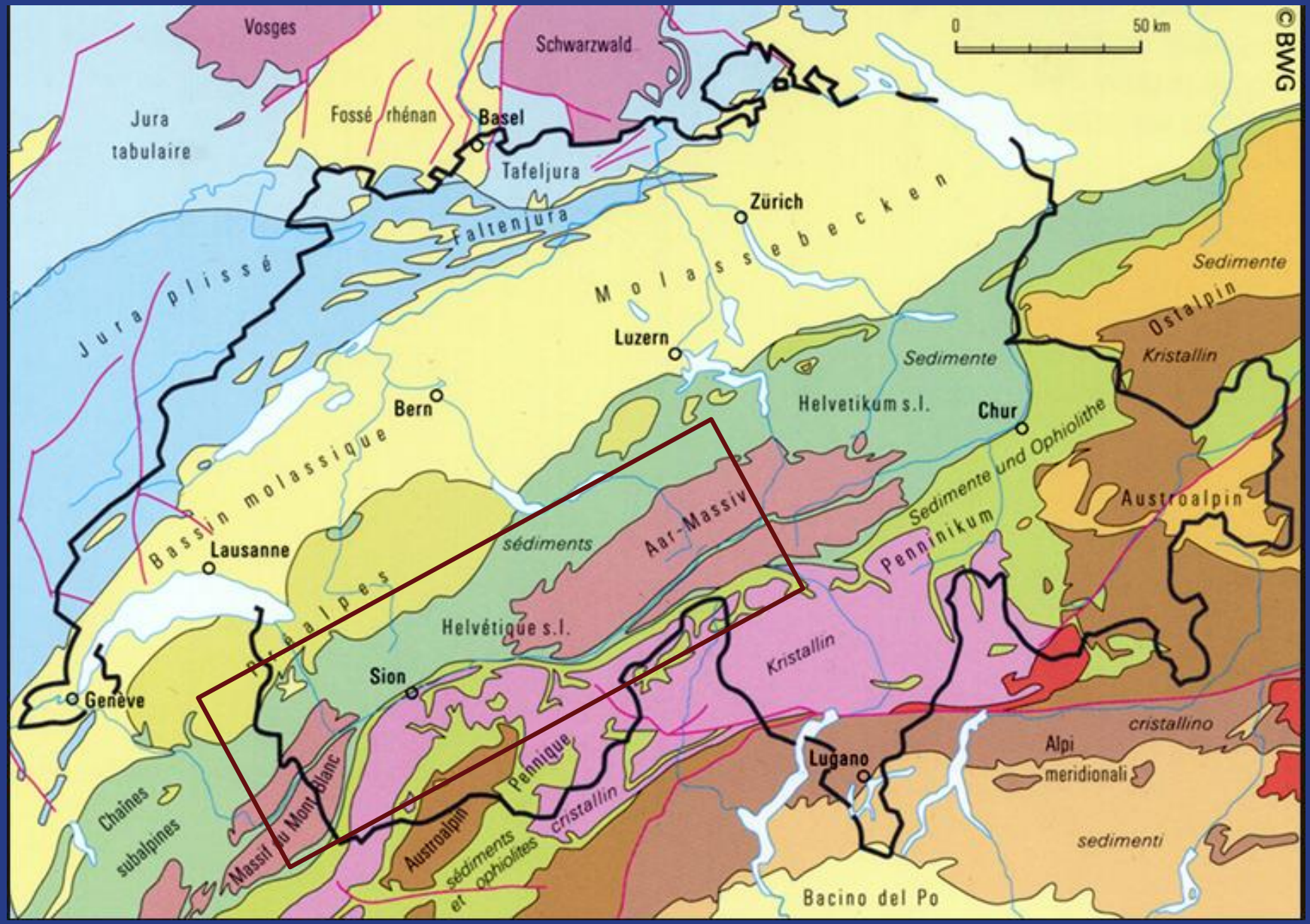
Morcles/Ardon/Doldenhorn/ Gellihorn/Plammis/Jägerchürz

Karbonifer havzası

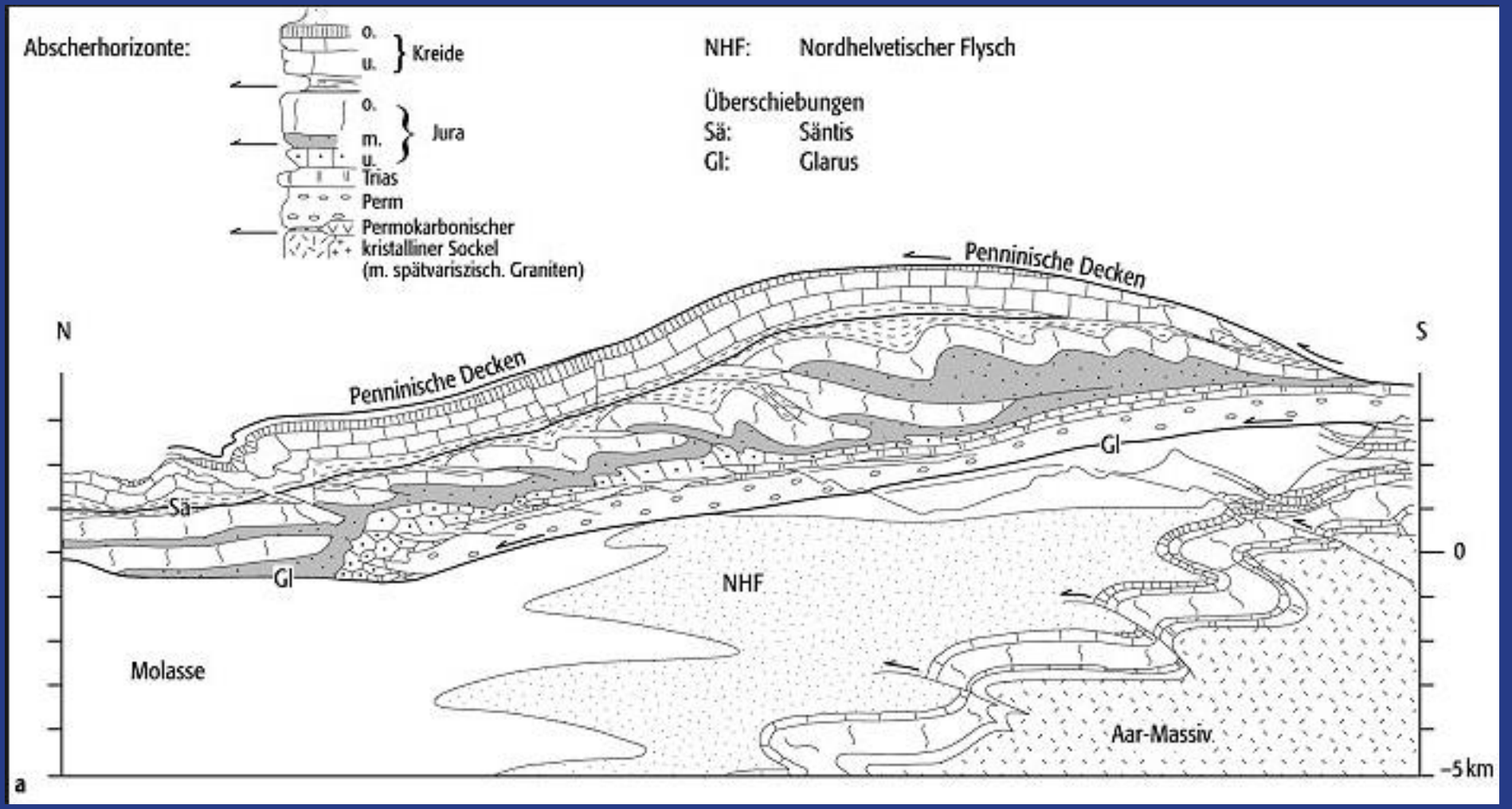
Temel ve çökel örtüsü



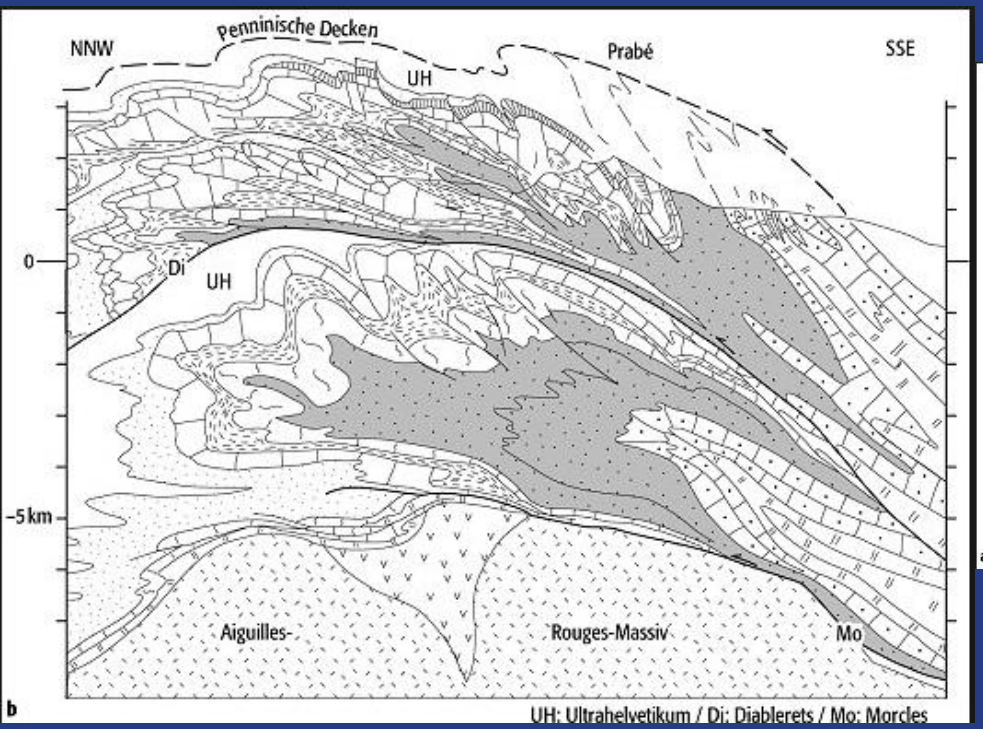
Morcles Napı-Aiguilles Rouges Masifi kontağı

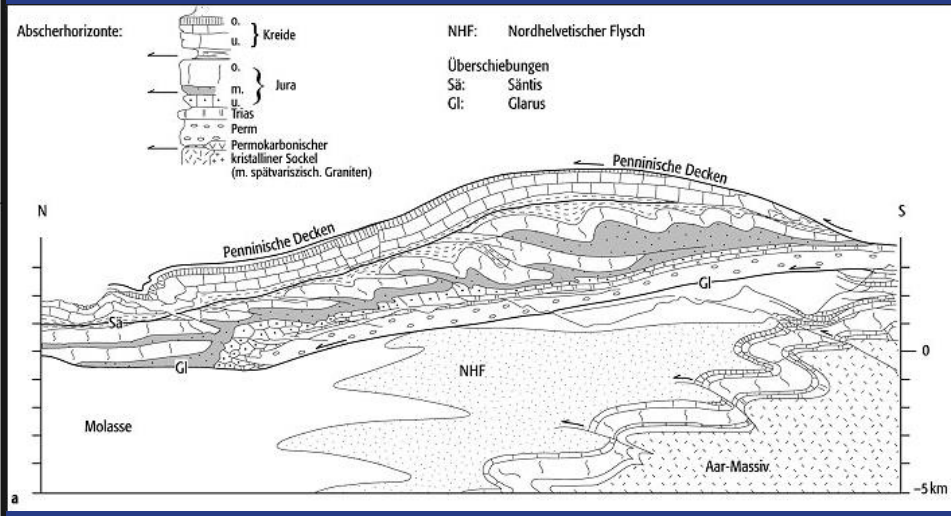


İsviçre’nin basitleştirilmiş bir tektonik haritası

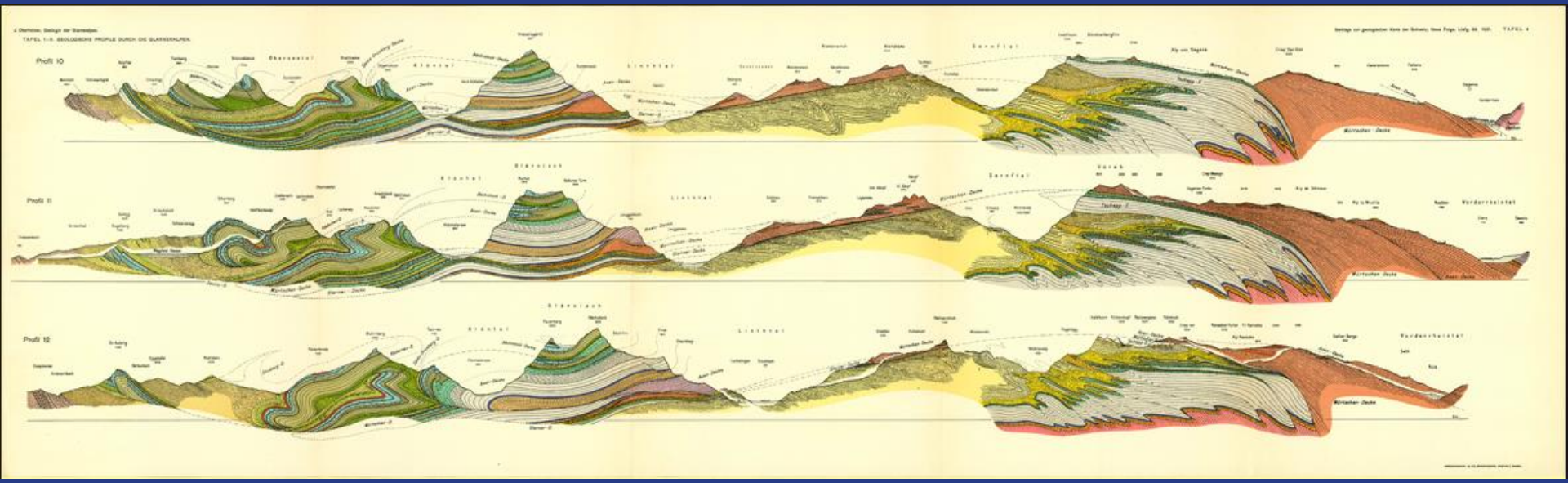


Aar Masifi üzerinde Helvetik Napları. Eskiden Pennin Napları da bunların üzerindeydi. Bugün erozyon Pennin Naplarını burada yok etmiştir.

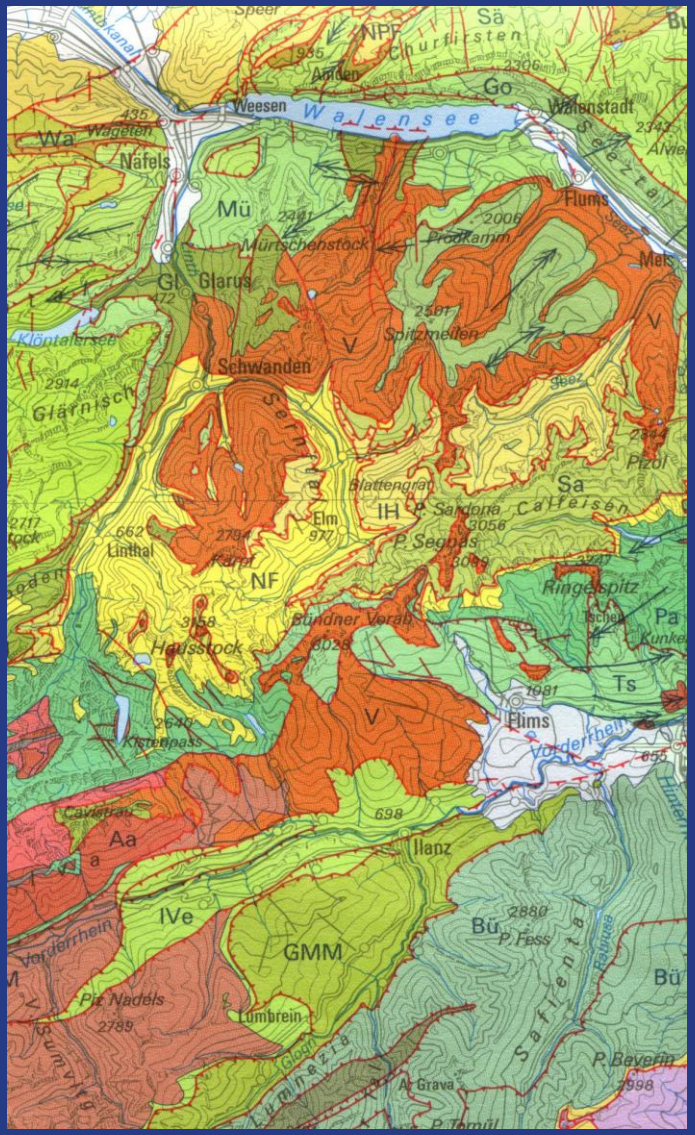




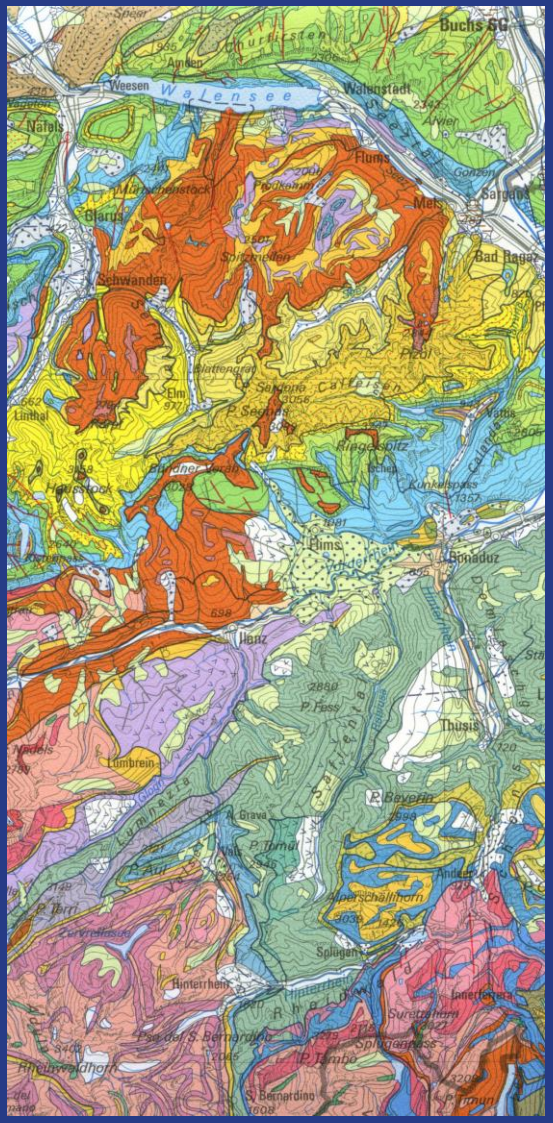
Alplerin batısında (solda) ve doğusunda (sağda) Helvetik nap geometrilerinde farklılıklar



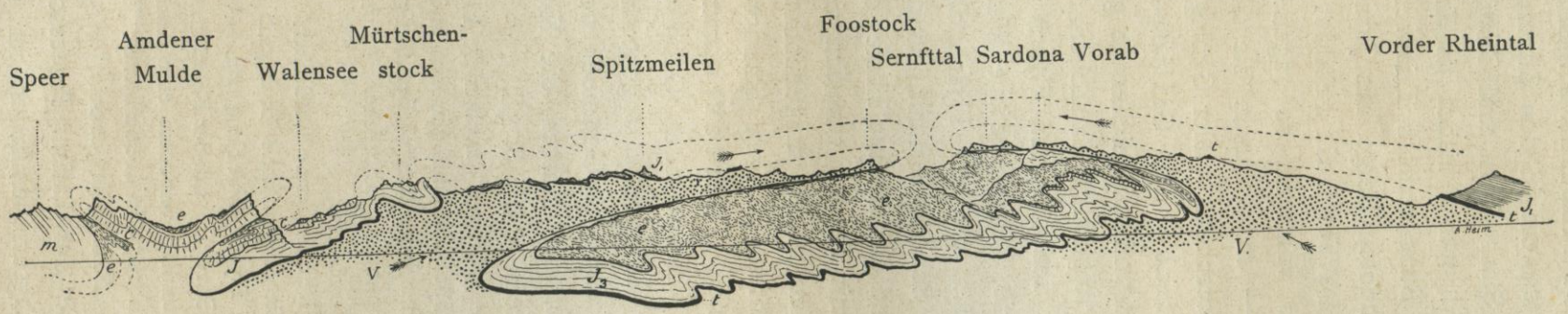
Glarus bindirmesinden kesitler: Jakob Oberholzer 1933



Glarus Napı ve çevresi tektonik haritası

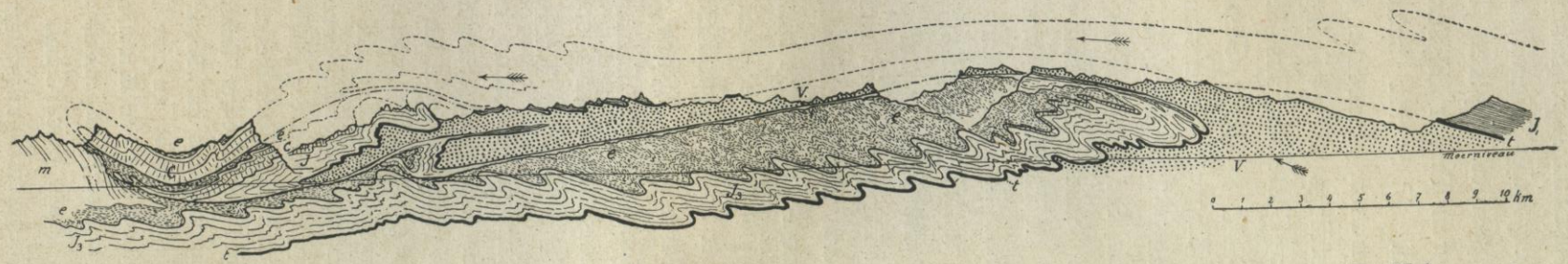


Glarus Napı ve çevresi jeolojik haritası



A. „Glarner-Doppelfalte" nach der Vorstellung von A. Escher und Alb. Heim 1870—1902.

Glarus çift kıvrımı



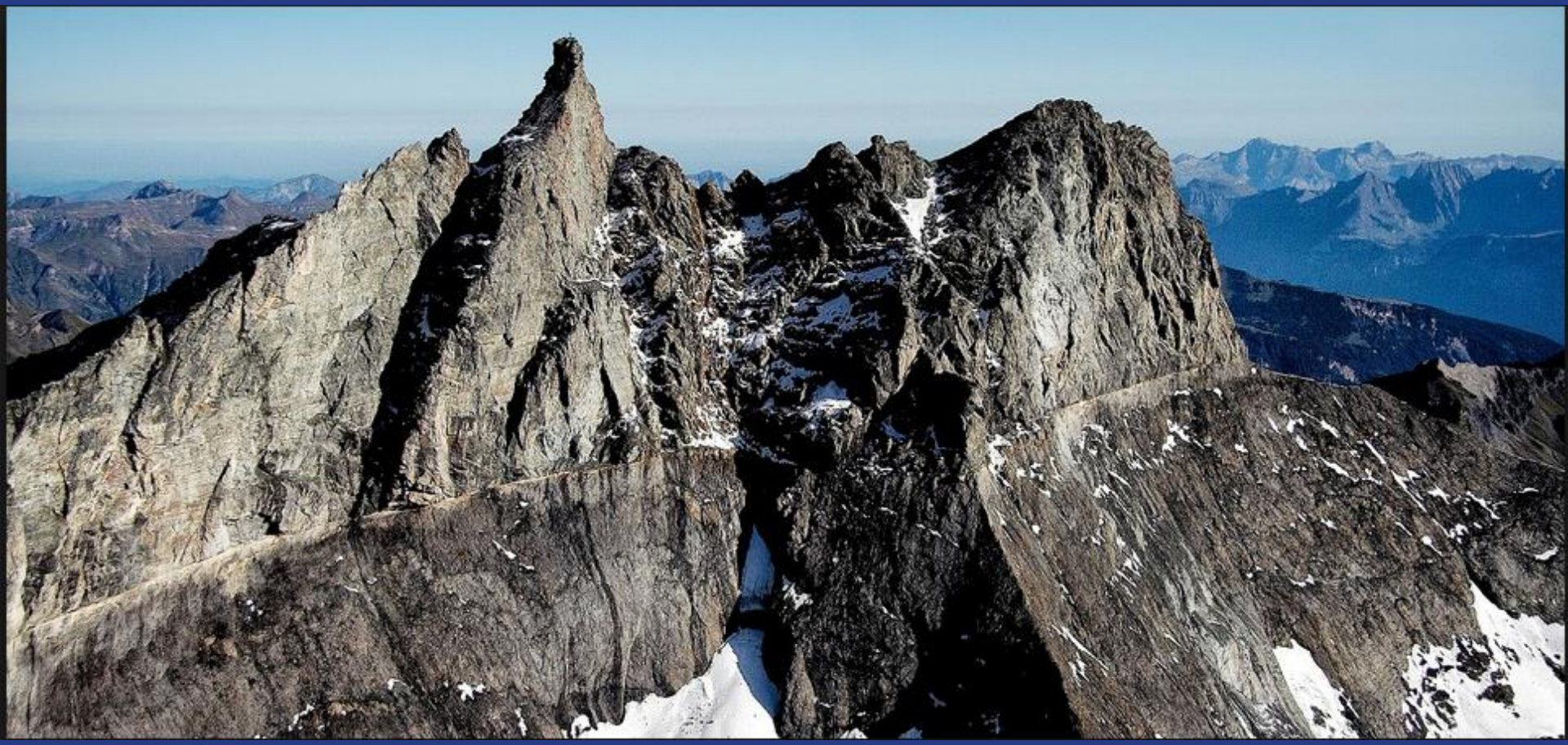
B. „Glarner-Deckfalten" nach der Vorstellung von M. Bertrand 1883 und E. Sueß 1892, angenommen von Alb. Heim 1903.

Fig. 5. Die Glarner-Deckfalten in schematischem Profil von N nach S nach älterer und neuerer Auffassung.

Glarus Napı

Glarus Napının iki yorumu: üstte: Escher 1854, 1866; altta Bertrand 1884

Sardona Tepesinde Glarus Bindirmesi (Lochseitenkalk açık sarı!)



Sardona Tepesinde Glarus bindirmesi, İsviçre Alpleri

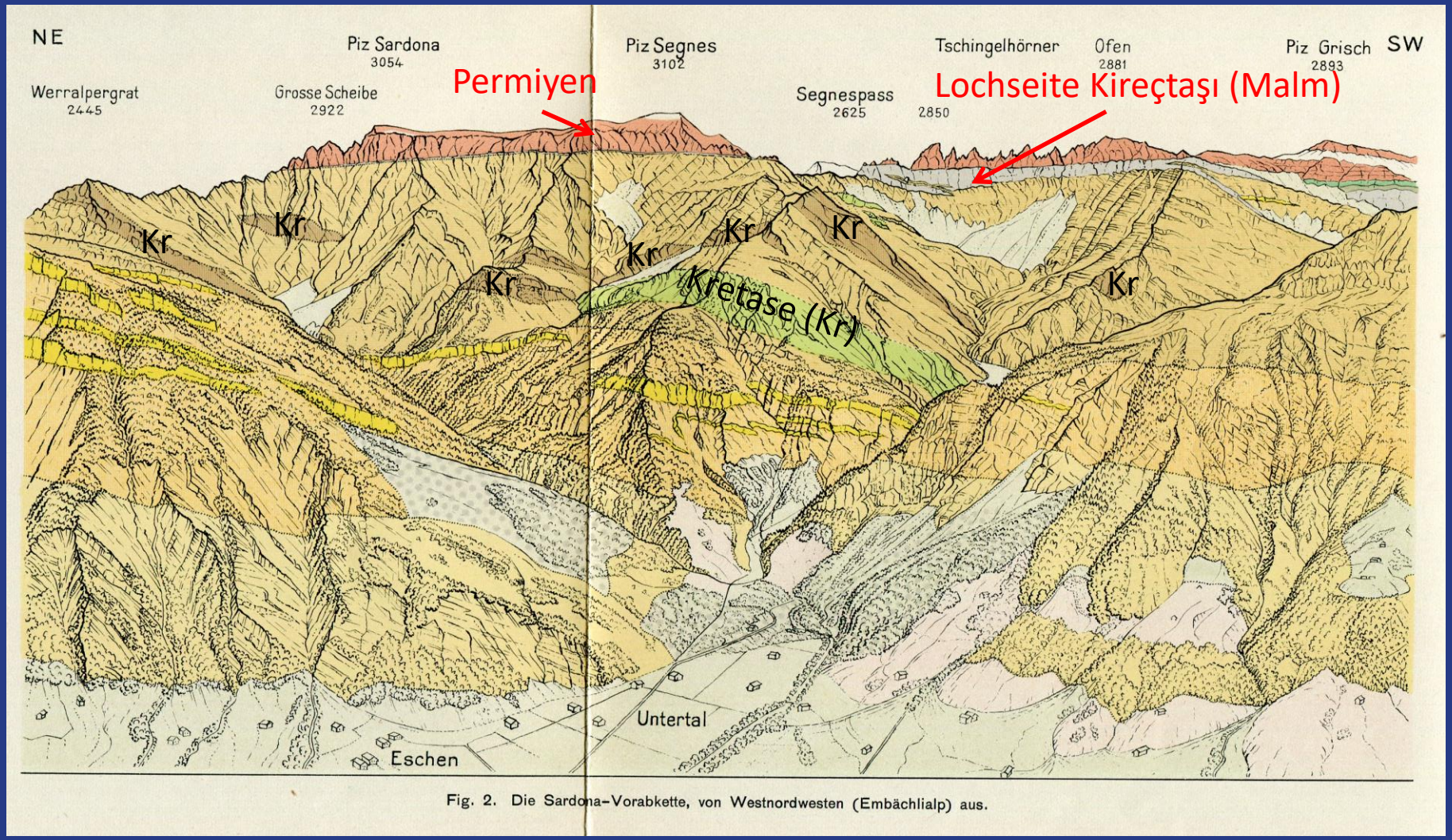


Fig. 2. Die Sardona-Vorabkette, von Westnordwesten (Embächlialp) aus.

Sardona Tepesi civarı jeolojisi (sarı ve boz renklerin hepsi Tersiyer) Oberholzer 1933

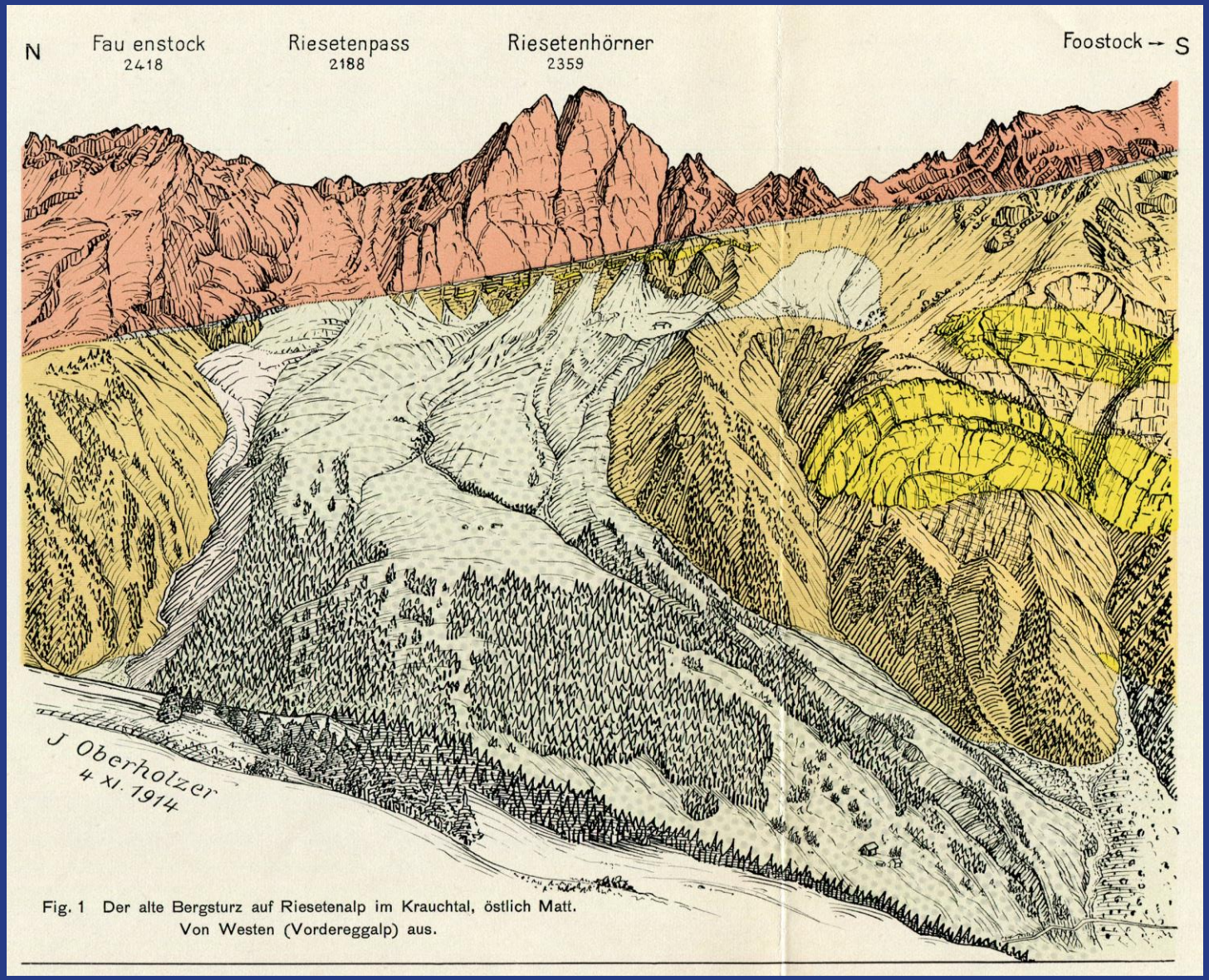


Fig. 1 Der alte Bergsturz auf Riesetenalp im Krauchtal, östlich Matt. Von Westen (Vordereggalp) aus.

Rieseten Geçidi ve Riesetenhörner tepeleri yakınlarında Glarus Napı (Oberholzer 1933)

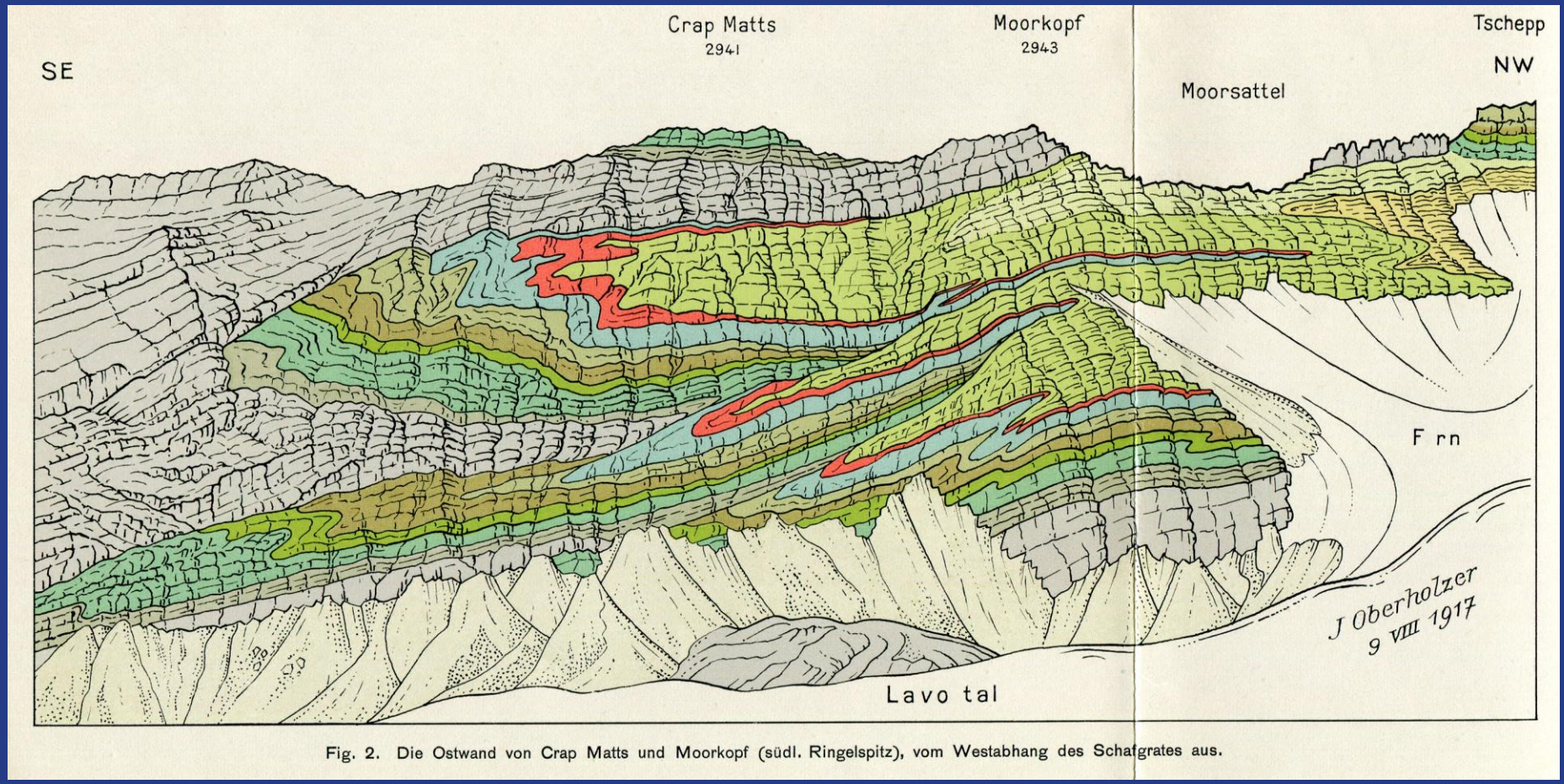


Fig. 2. Die Ostwand von Crap Matts und Moorkopf (südl. Ringelspitz), vom Westabhang des Schafgrates aus.

Glarus bindirmesi altında kıvrımlı dilimler (Oberholzer 1933)

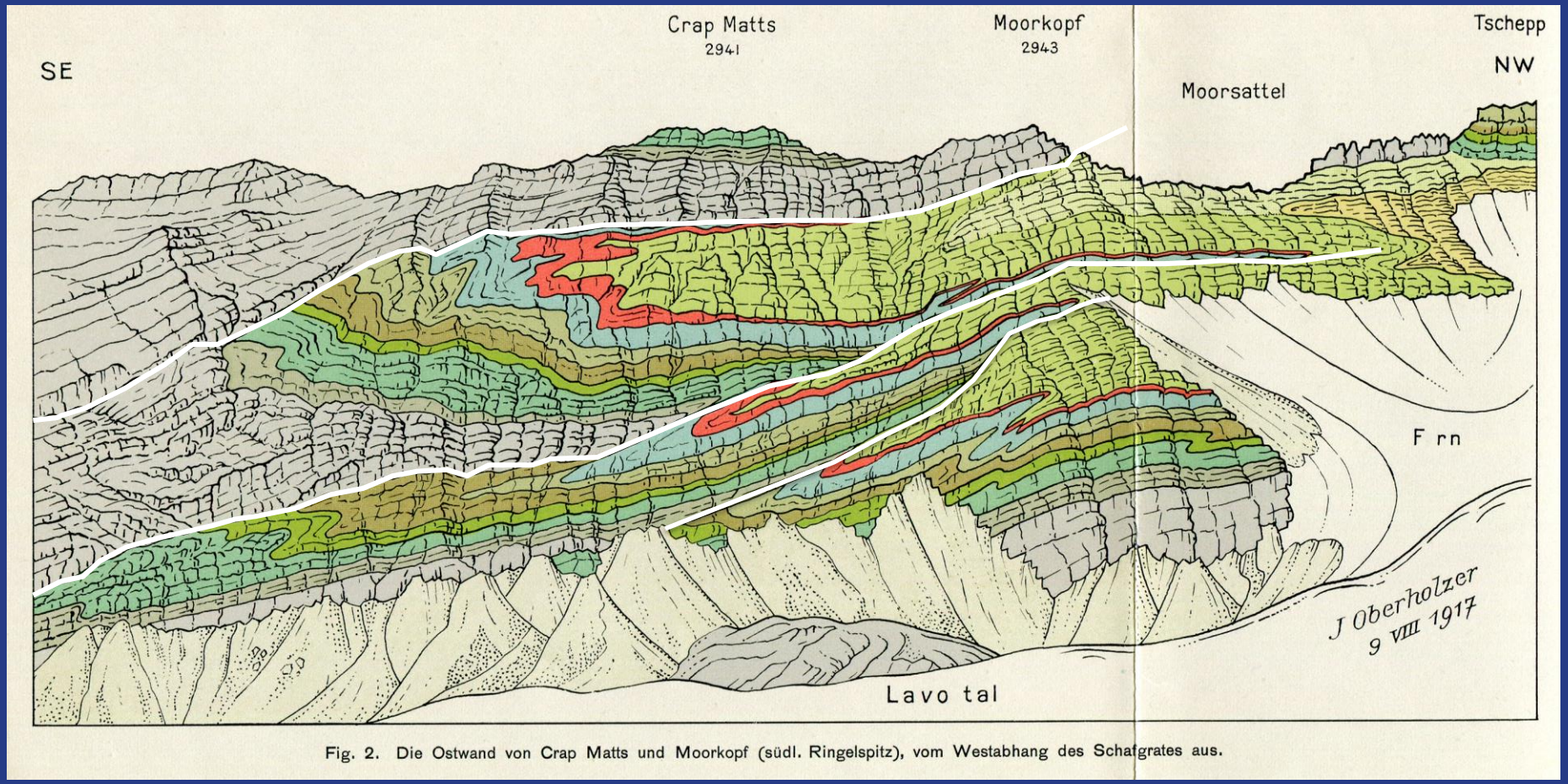
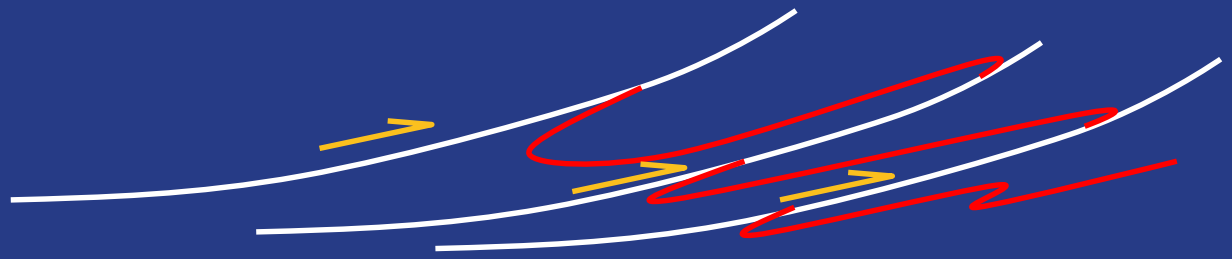


Fig. 2. Die Ostwand von Crap Matts und Moorkopf (südl. Ringelspitz), vom Westabhang des Schafgrates aus.



Glarus bindirmesinin mostrası: Lochseite, Schwanden, Glarus Kantonu, İsviçre

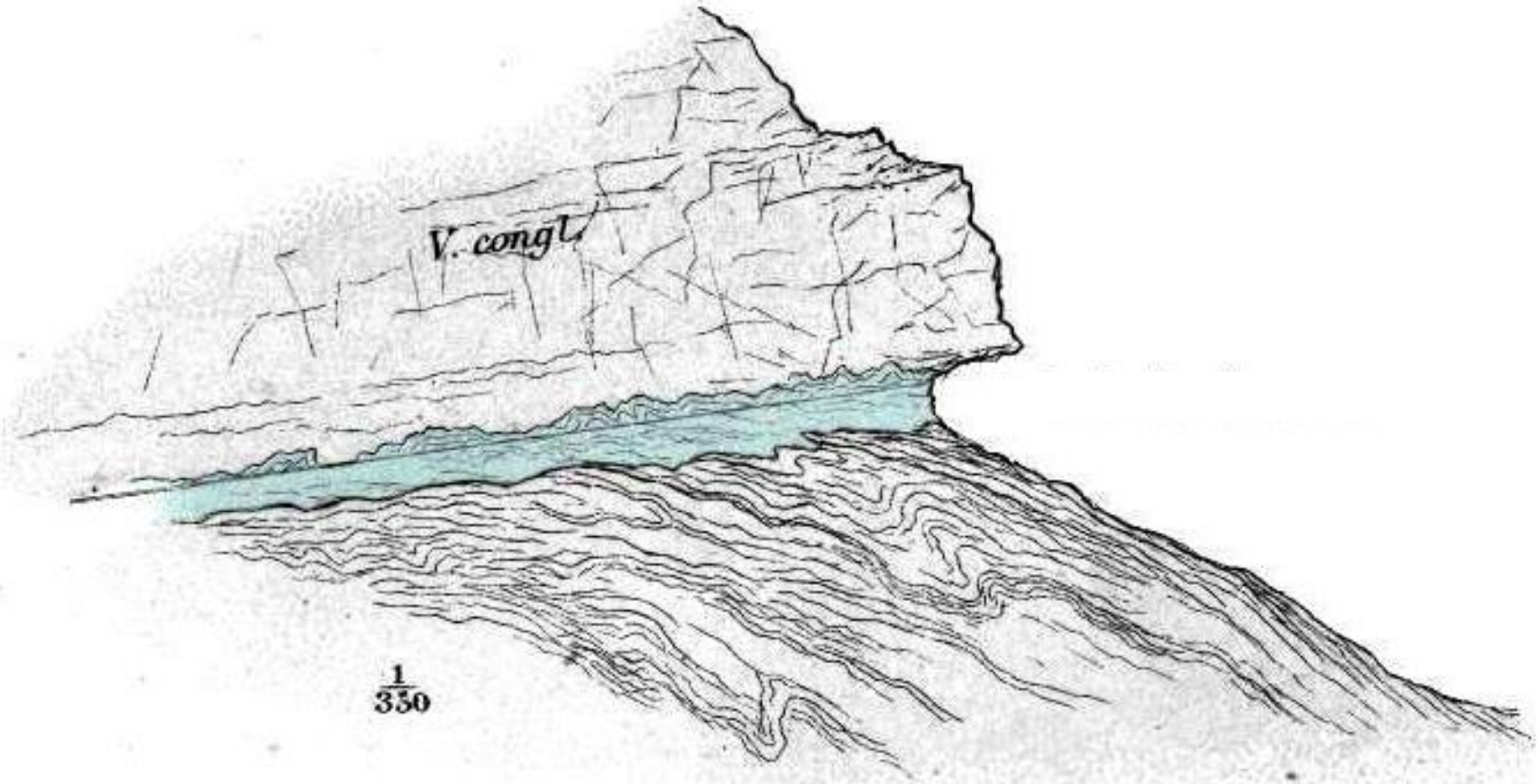


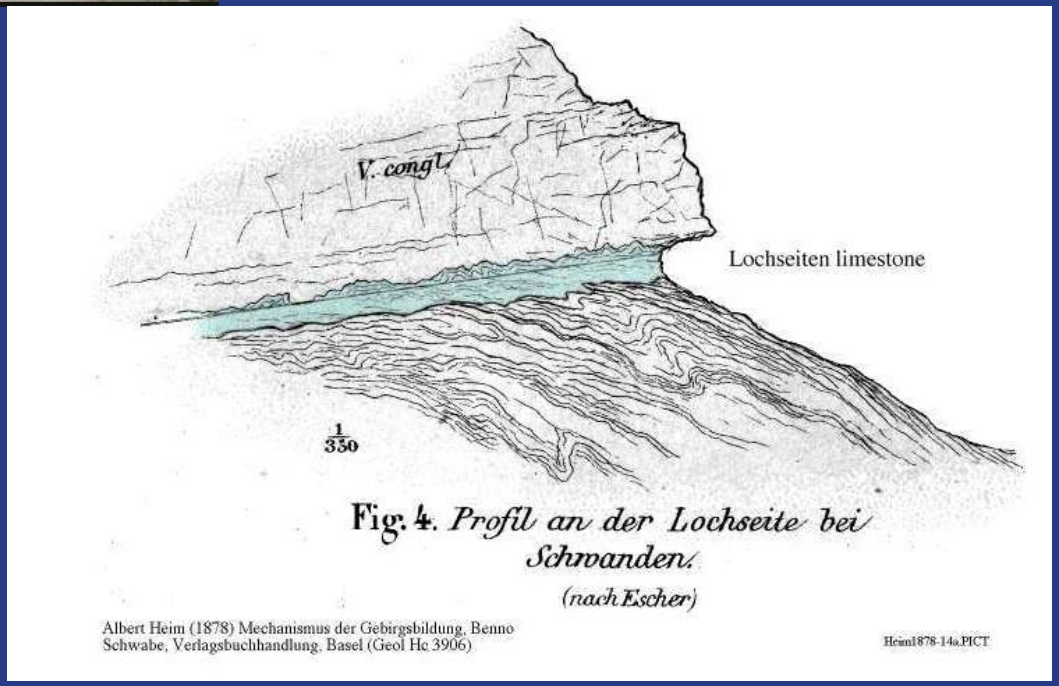
Fig. 4. *Profil an der Lochseite bei Schwanden.*
(nach Escher)

Albert Heim (1878) Mechanismus der Gebirgsbildung, Benno Schwabe, Verlagsbuchhandlung, Basel (Geol Hc 3906)

Heim1878-14a.PICT

Albert Heim'in defterinden Lochseite'de Glarus bindirmesinin mostrası (1870'ler)

Lochseite mostrası ve Heim’in çizimi

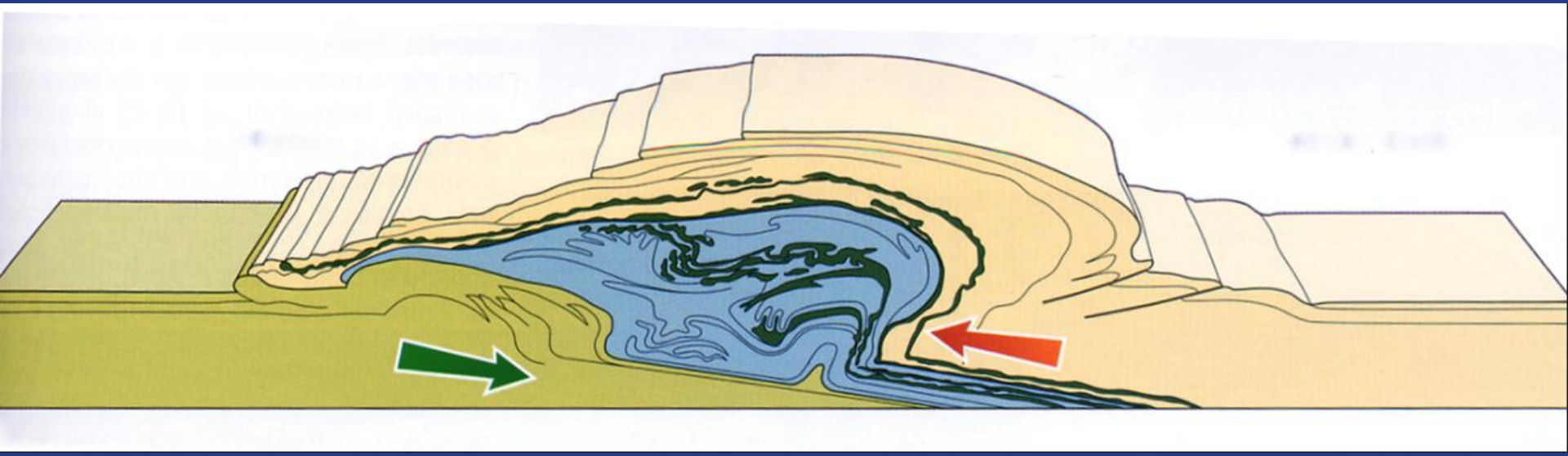


Düşük açılı bindirme fayı

Glarus, İsviçre

Düşük açılı normal fay

Alaşehir, Türkiye



Émile Argand’ın Alplerden çizdiği kesit (1924). Bu kesitin kalınlığı yaklaşık 30 km’dir. Argand sadece yüzeyde yaplan haritalardan dağ kuşağının 30 km. derinlikteki yapısını nasıl çıkartmıştı?

LES

NAPPES DE RECOUVREMENT

DES

ALPES OCCIDENTALES

et les territoires environnants

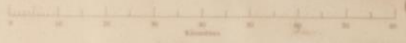
Essai de carte structurale

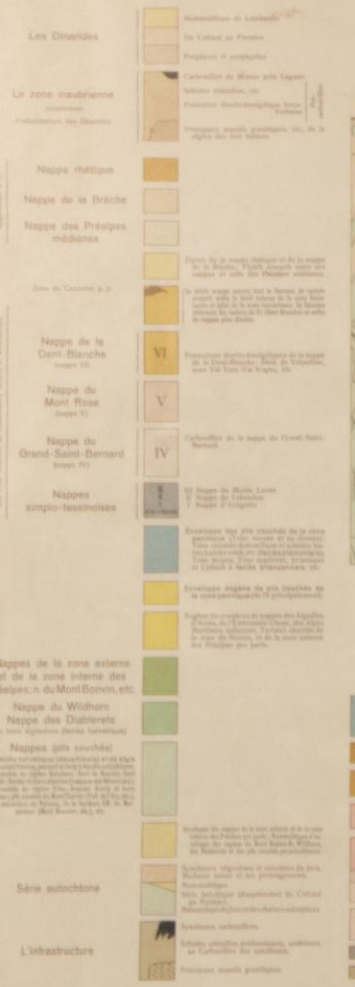
par

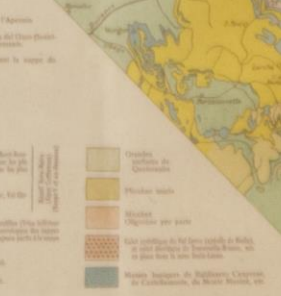
EMILE ARGAND

1902—1911

Echelle 1 : 500.000

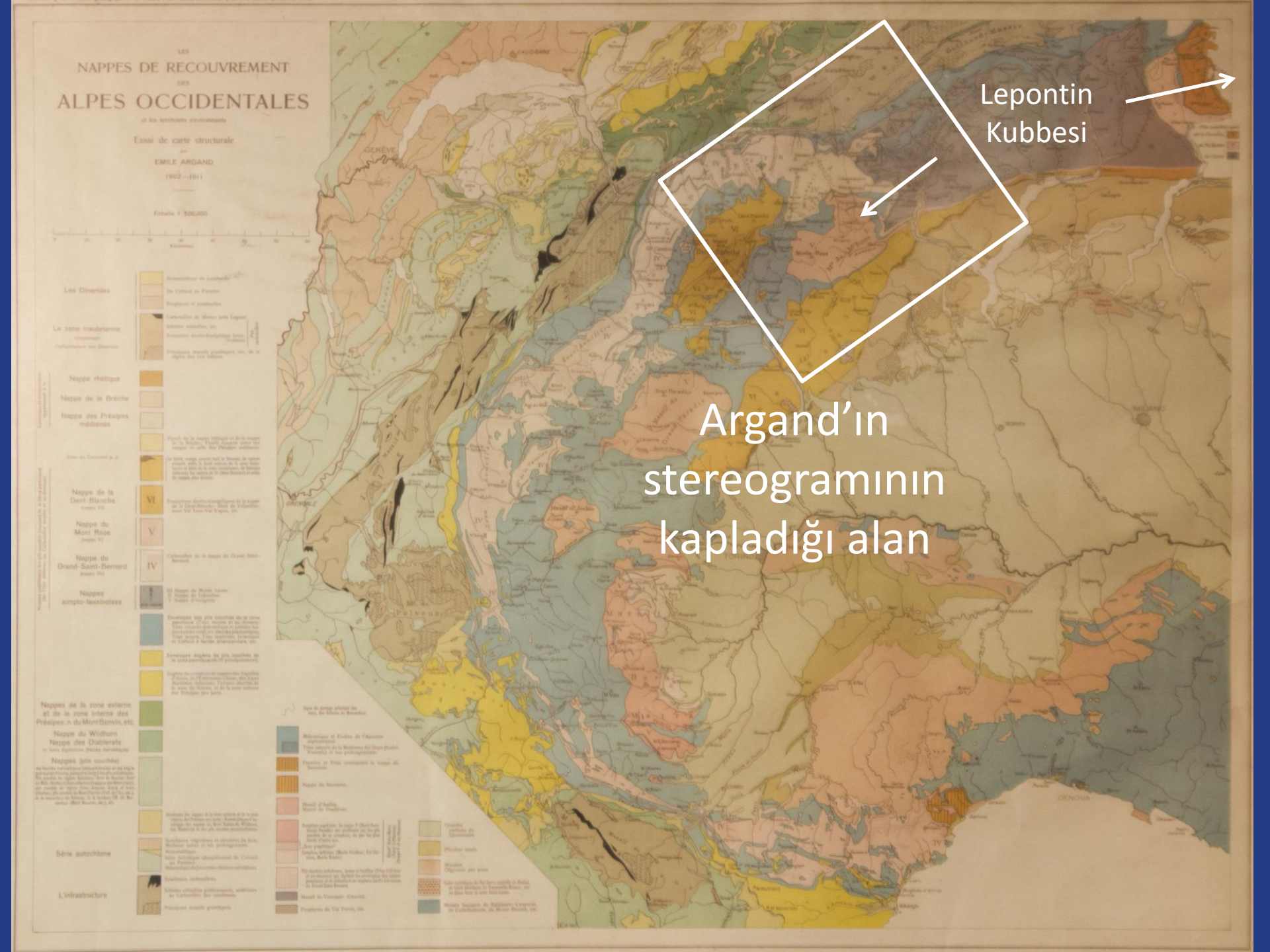






LES GRANDS PLIS COUCHÉS DES ALPES PENNINES

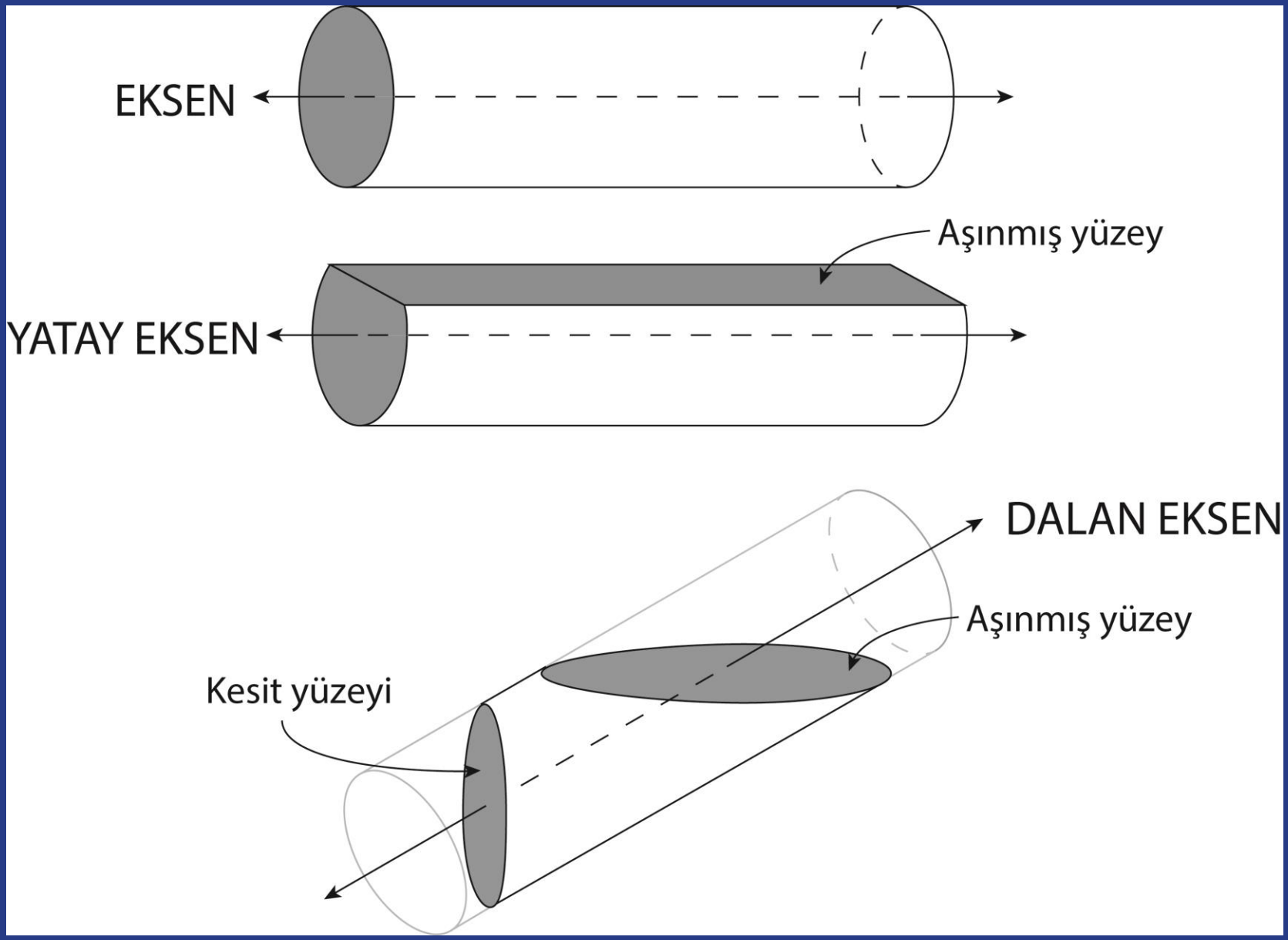
par EMILE ARGAND (1900 – 1951)


NAPPES DE RECOUVREMENT
DES
ALPES OCCIDENTALES
Essai de carte structurale
par
EMILE ARGAND
1902—1911
Lepontin
Kubbesi
Argand'ın
stereogramının
kapladığı alan

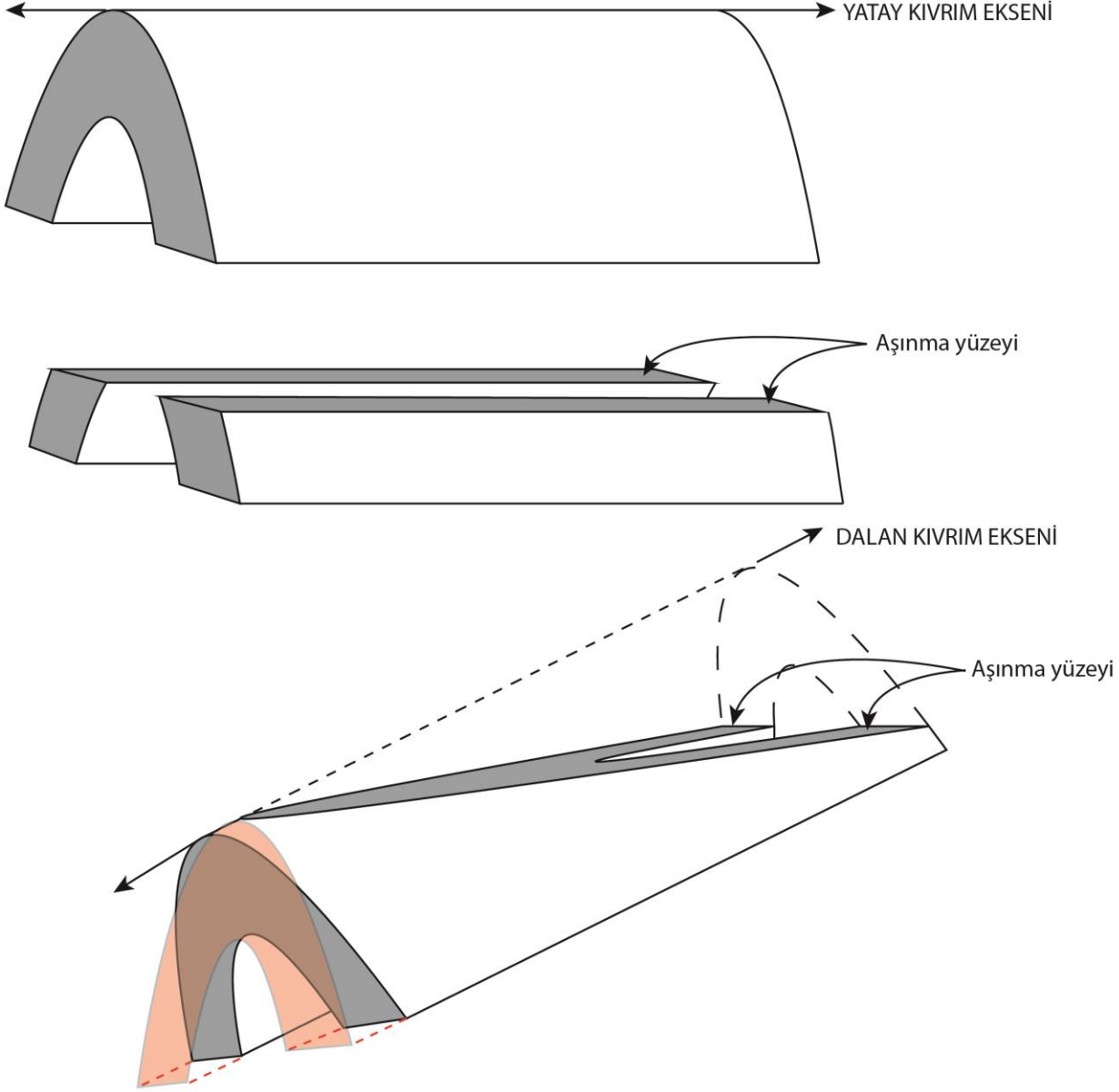
Stéréogramme tectonique des Alpes Pennines.

Les synclinaux de la zone pennique sont supposés vidés de leur contenu.

Eksen dalımını kullanarak napların derindeki yapılarının çıkarılması: Argand 1911



Eksen dalımı yöntemiyle bir silindirin derinde kesidini çizmek



Eksen dalımı yöntemiyle dalan bir kıvrımın kesidini çizmek

Beiträge zur geolog. Karte der Schweiz, n. F. Liefg. XXXI. Taf. III.

Stéréogramme tectonique des Alpes Pennines.

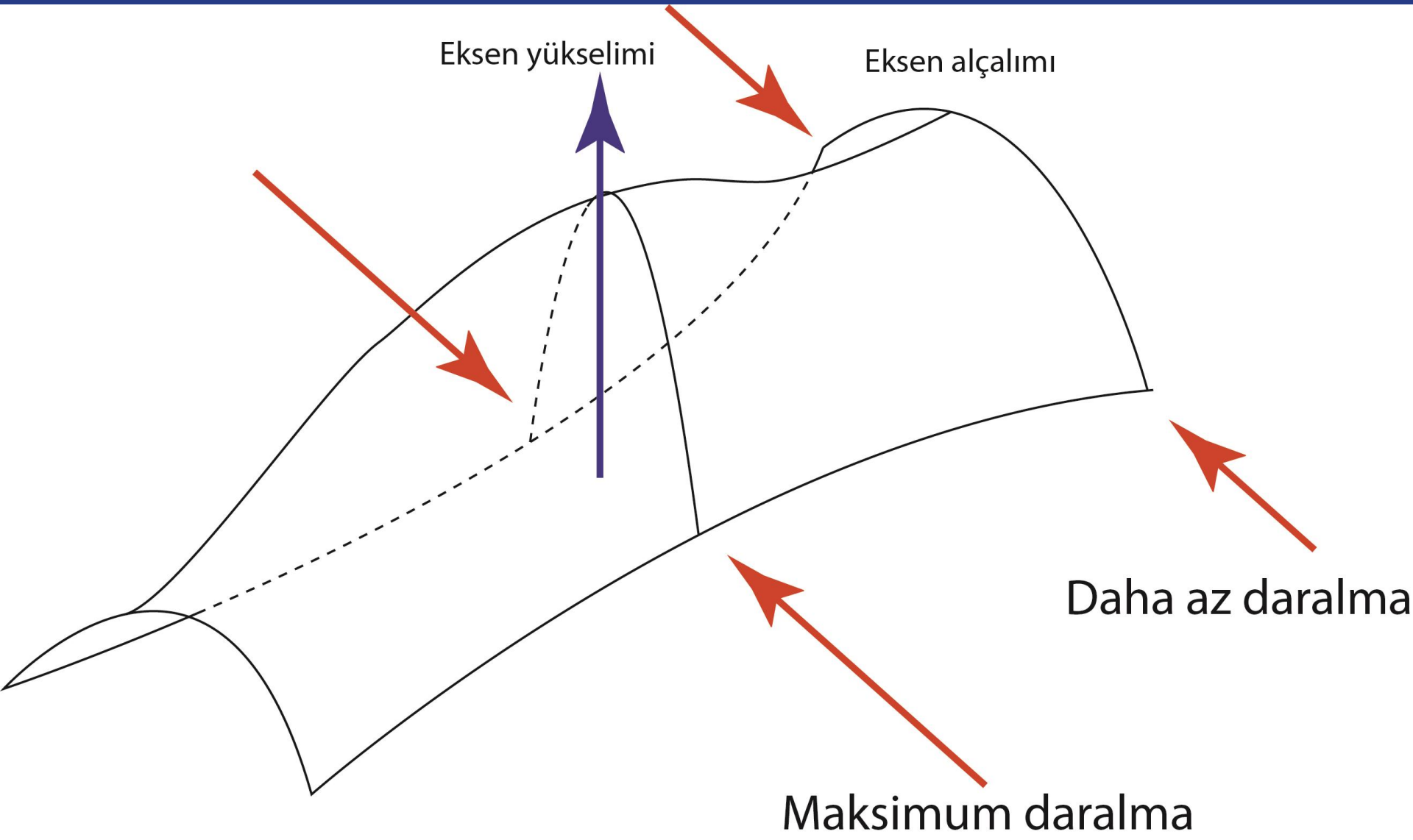
Les synclinaux de la zone pennique sont supposés vidés de leur contenu.

Pennin Alplerinin stereogramı

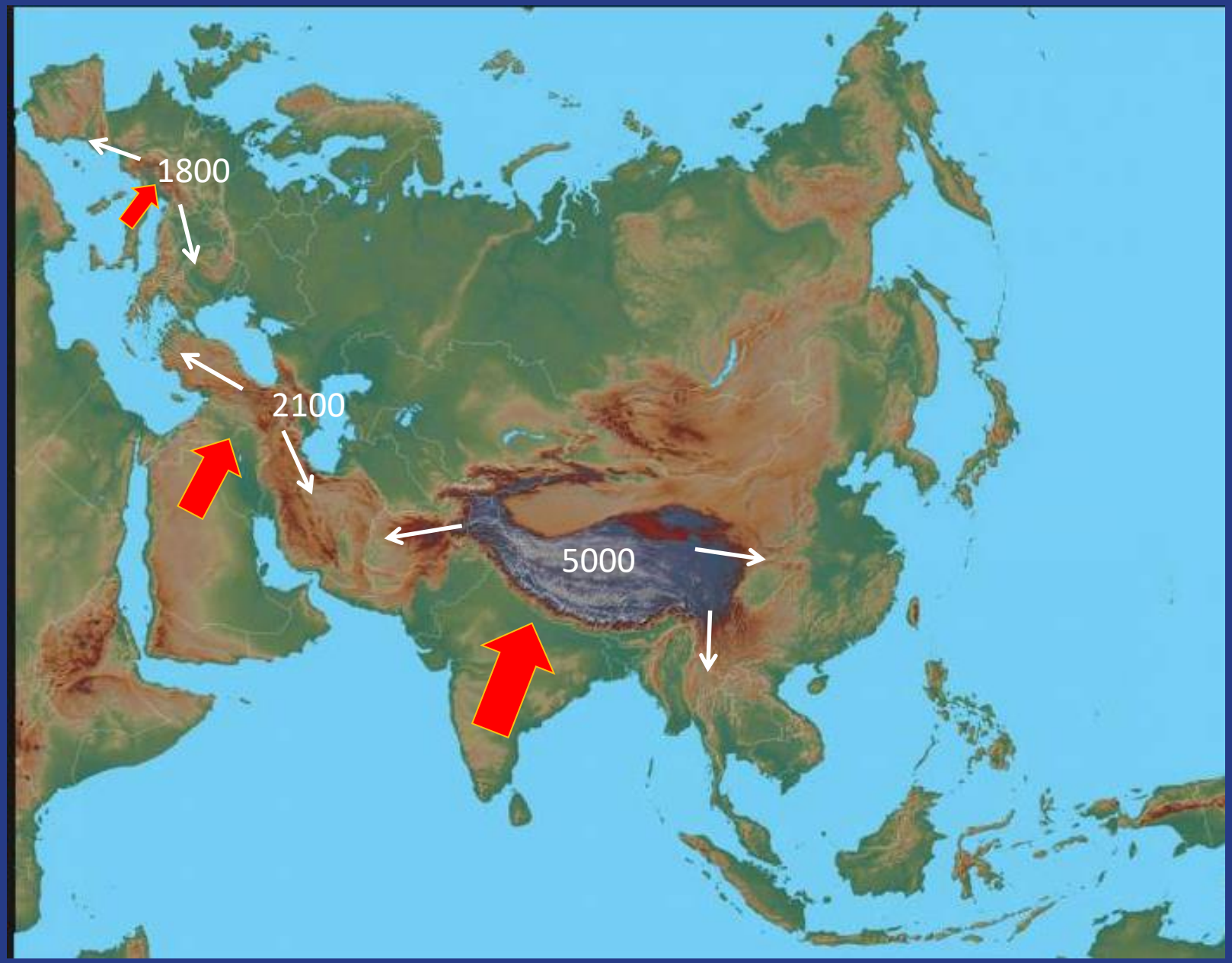
Eksen dalımı yöntemiyle Argand'ın Alplerin derin yapısını ortaya çıkarması

LES GRANDS PLIS COUCHÉS DES ALPES PENNINES

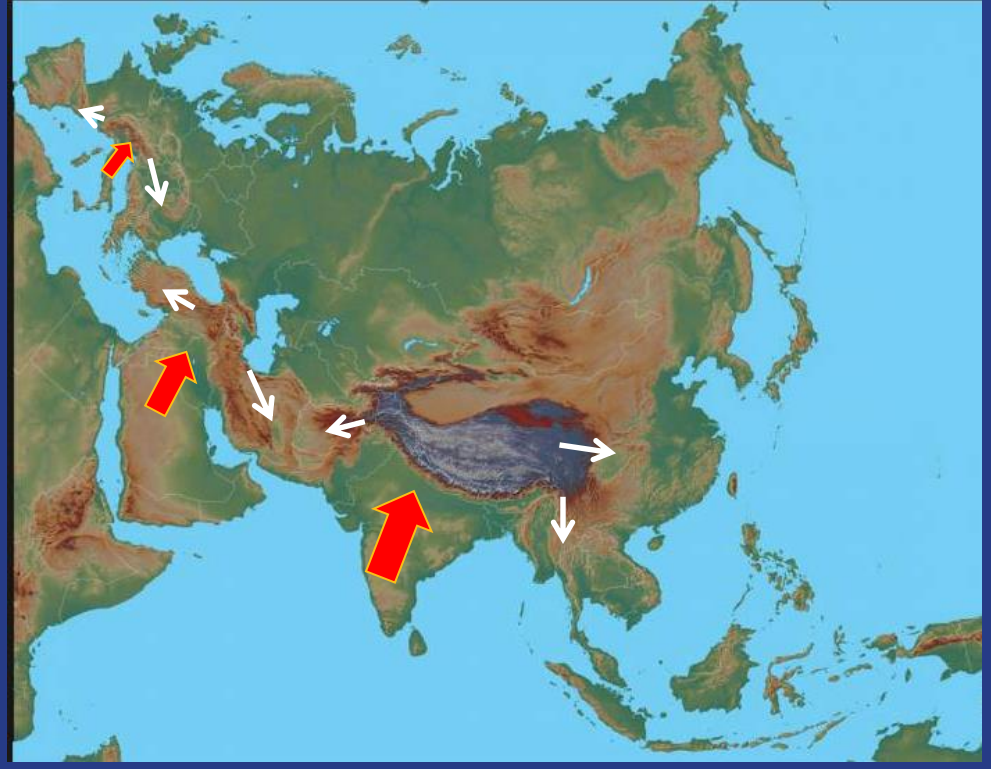
par EMILE ARGAND (1900 – 1951)



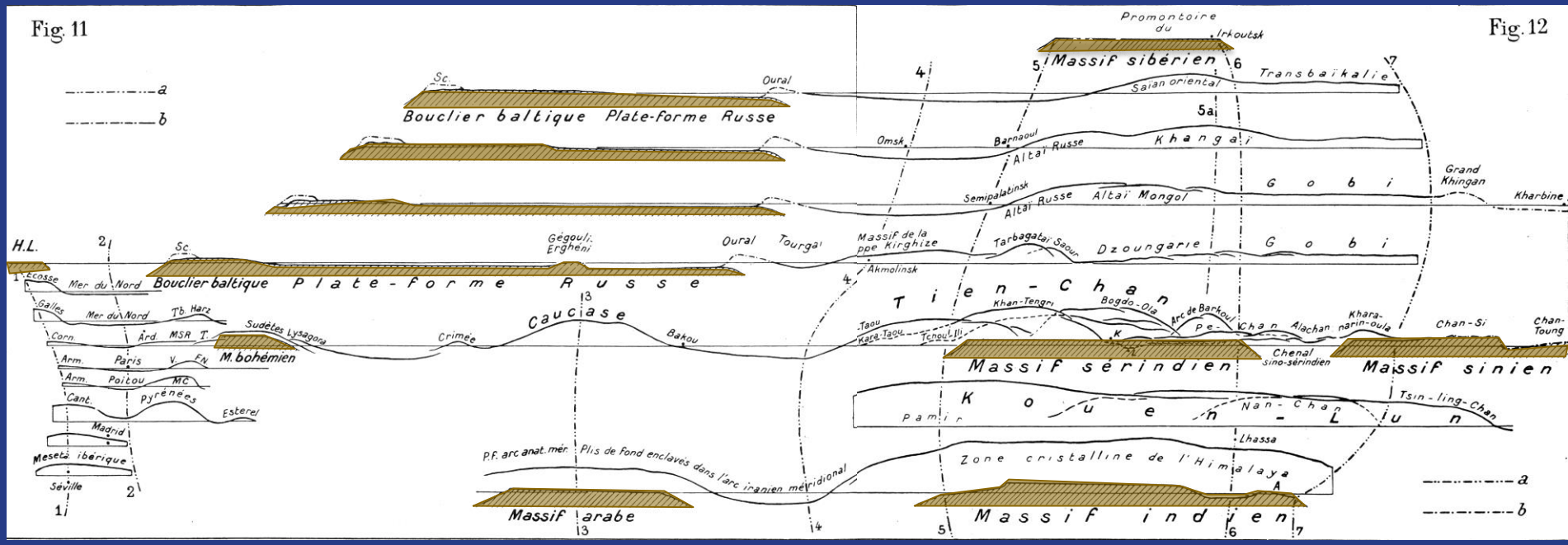
Kıvrım ekseni yüksekliği salınımları

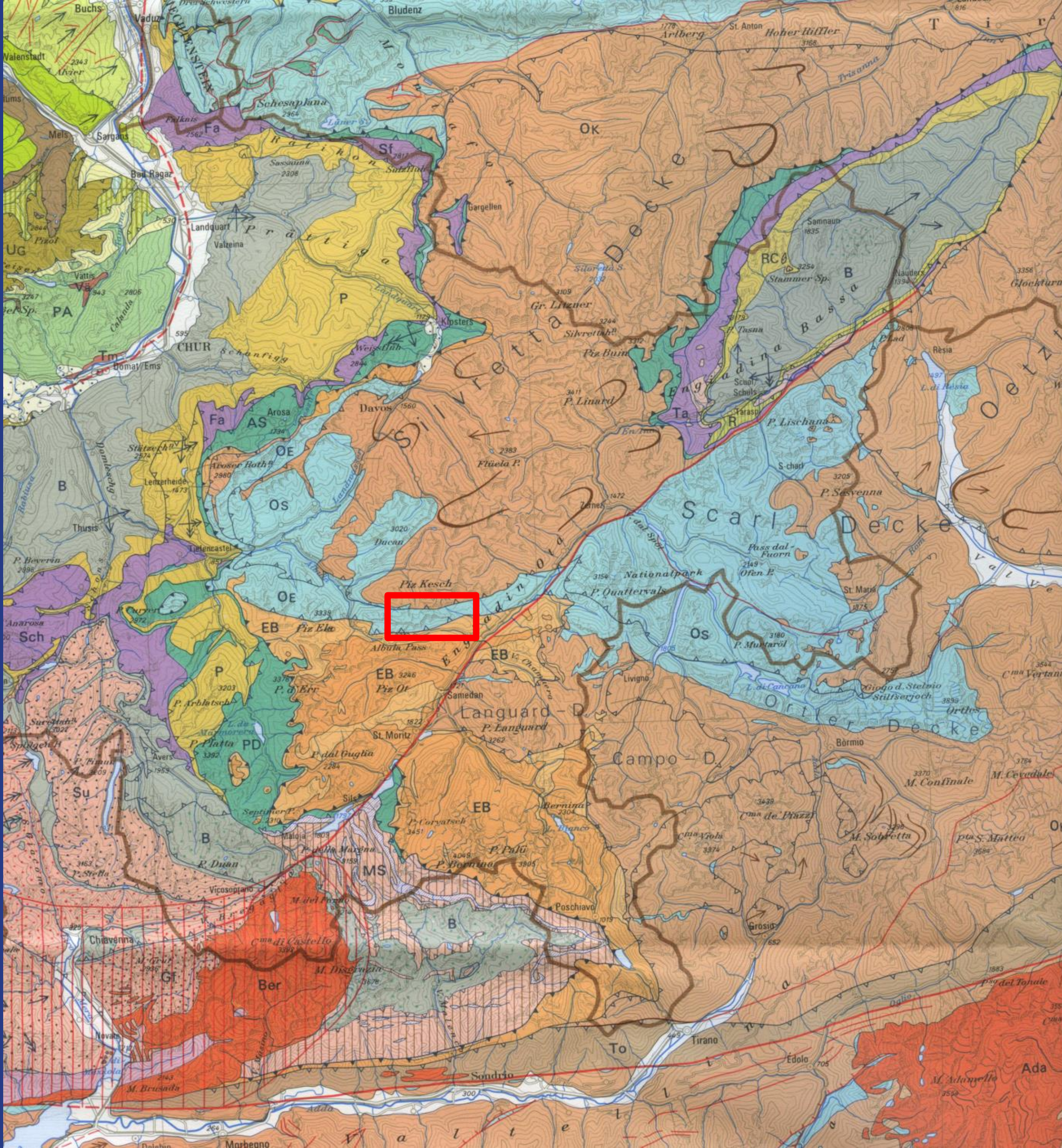


Avrasya’da Alp-Himalaya sistemi boyunca eksen salınımları

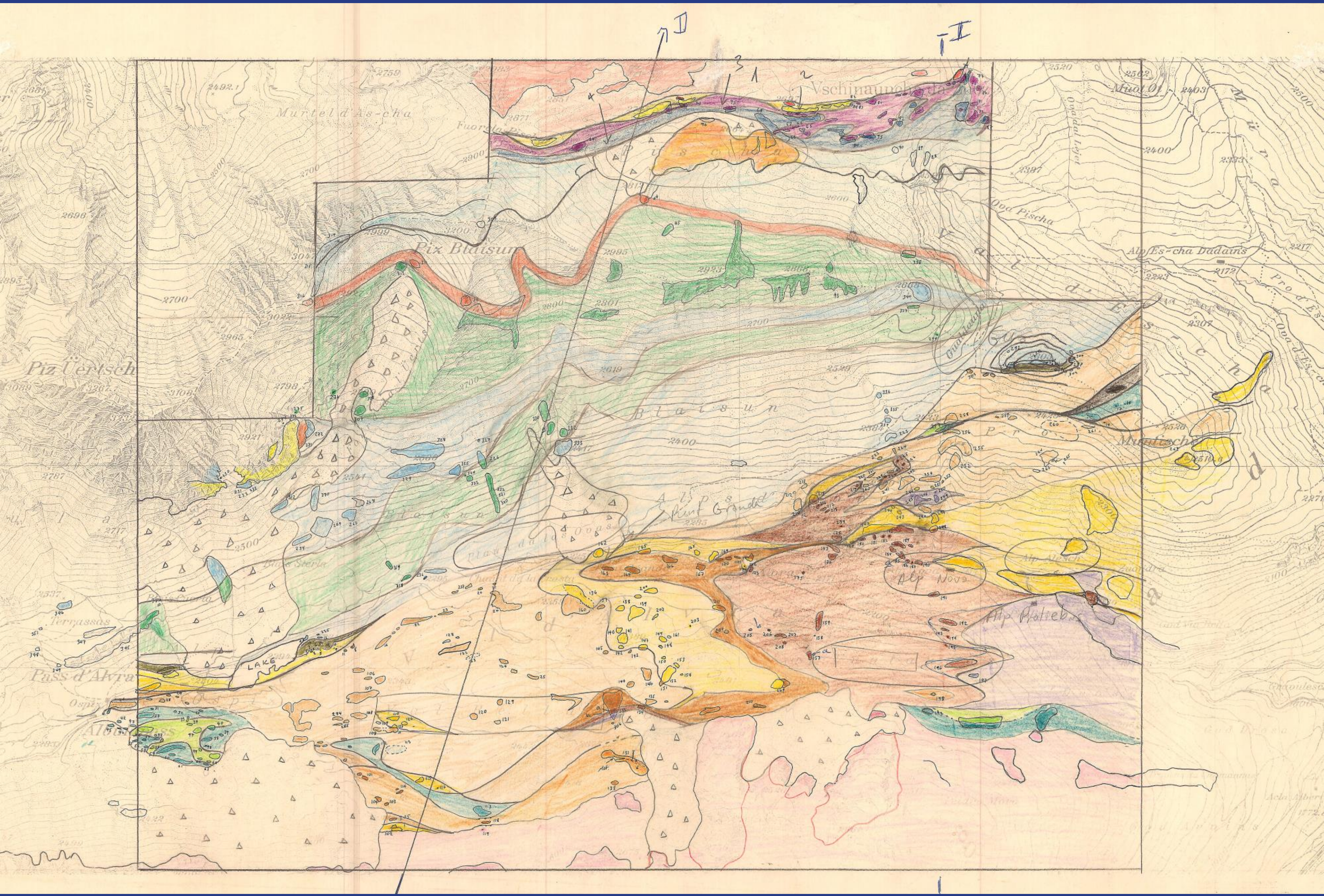


Avrasya'nın Alpid dönemdeki eksen salınımları (Argand, 1924)

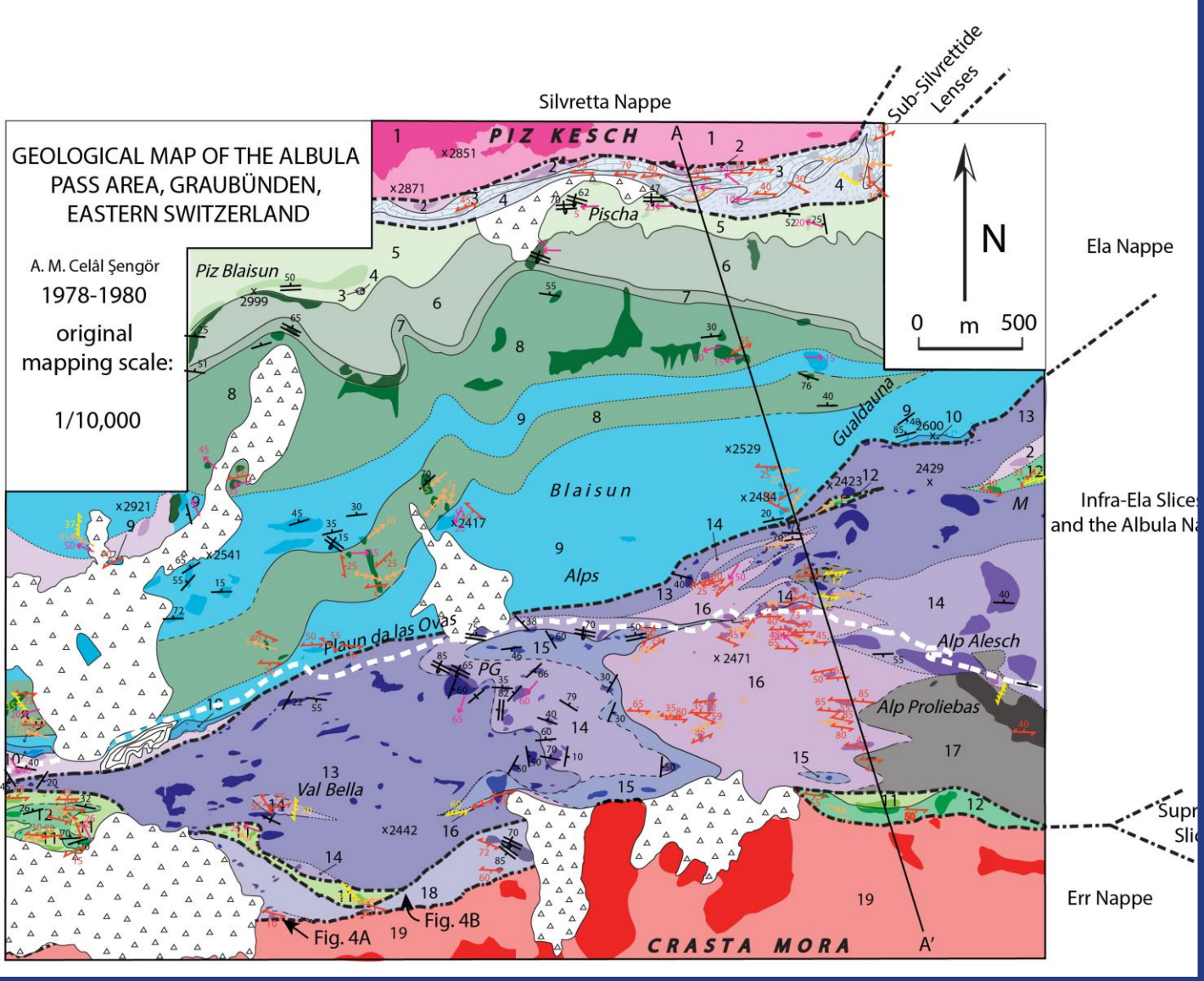




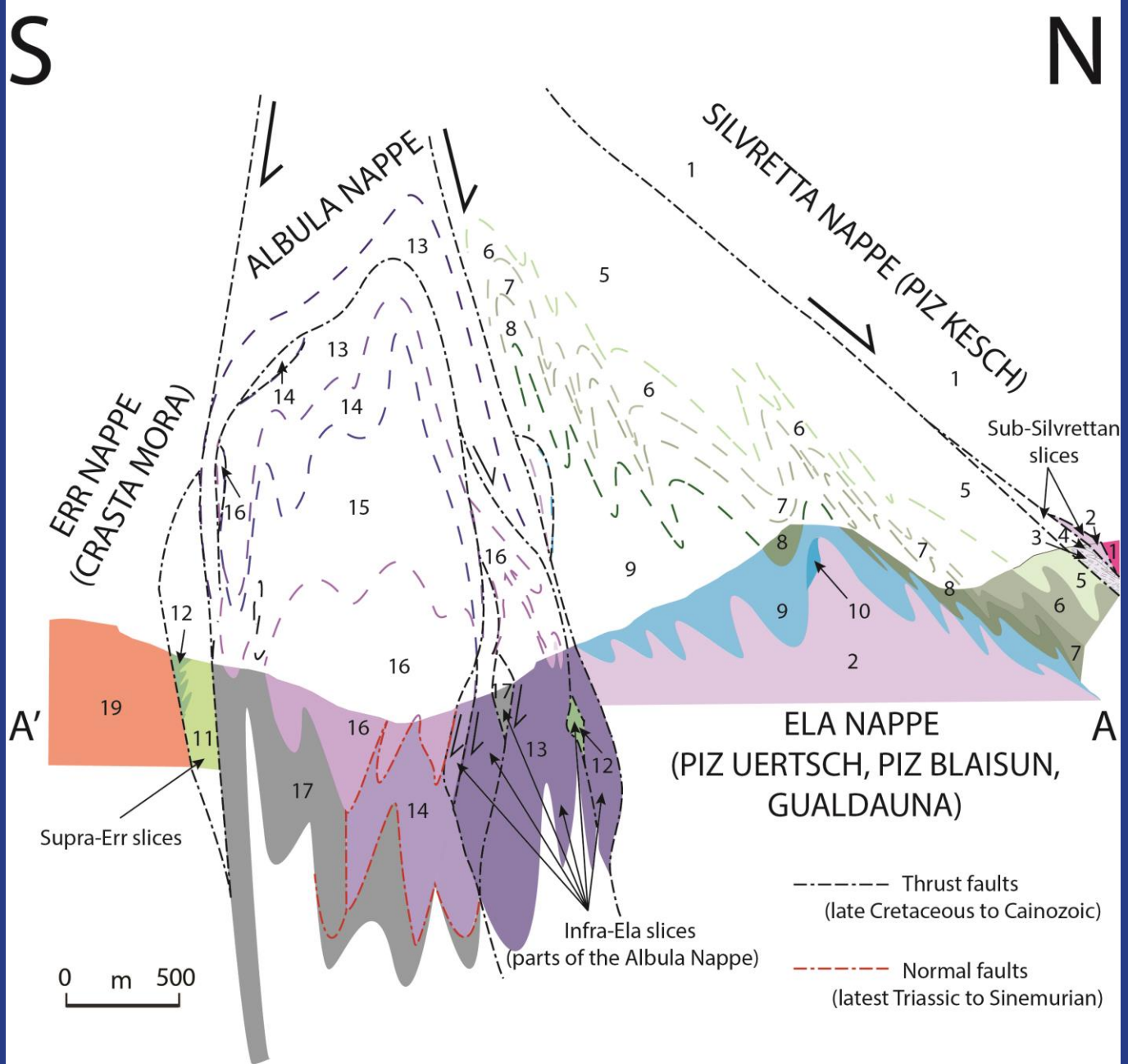
Buchs
Vaduz
Bludenz
Walenstadt
Sargans
Bad Ragaz
Mels
Fa
Sf
Schesaplana
Rätikon
Arlberg
St. Anton
Hoher Riffler
Tirol
Trisanna
Oκ
Silvretta - Decke
Gargellen
Landquart
Valzeina
Prättigau
P
UG
PA
Calanda
CHUR
Tm
Domat/Ems
Klosters
Weissfluh
Davos
Fa
AS
Arosa
Oε
Os
Aroser Rothorn
Lenzerheide
B
Thusis
Tiefencastel
P. Beverin
Sch
Gr. Litzner
Silvretta
Piz Buin
P. Linard
Flüela P.
Zernez
Samnaun
RC
Stammer Sp.
B
Engiadina Bassa
Nauders
Scuol
Schuls
Ta
R
Tarasp
Resia
L. di Resia
Glockturm
Oetztal
P. Lischana
S-charl
P. Sesvenna
Scarl - Decke
Pass dal Fuorn
Ofen P.
Nationalpark
P. Quattervals
St. Maria
Ducan
Piz Kesch
Oε
EB
Piz Ela
Albula Pass
Engiadin' Ota
EB
Piz Ot
EB
P. d'Err
Samedan
Languard - D.
P. Languard
St. Moritz
P
P. Arblatsch
PD
P. Platta
Avers
Os
P. Murtaröl
Livigno
L. di Cancano
Giogo d. Stelvio
Stilfserjoch
Ortles
Ortler - Decke
C^ma Vertana
Campo - D.
Bormio
M. Confinale
M. Cevedale
C^ma de' Piazzi
C^ma Viola
M. Sobretta
P^ta S. Matteo
Oκ
Su
Sils
P. dal Güglia
Septimer P.
Maloja
B
P. Duan
Vicosoprano
MS
EB
P. Corvatsch
P. Palü
P. Bernina
Bernina
Poschiavo
Grosio
B
Chiavenna
Gf
Ber
M. Disgrazia
To
Tirano
Edolo
P^so del Tonale
M. Adamello
Ada
Sondrio
Novate
M. Brusada
Morbegno
Valtellina

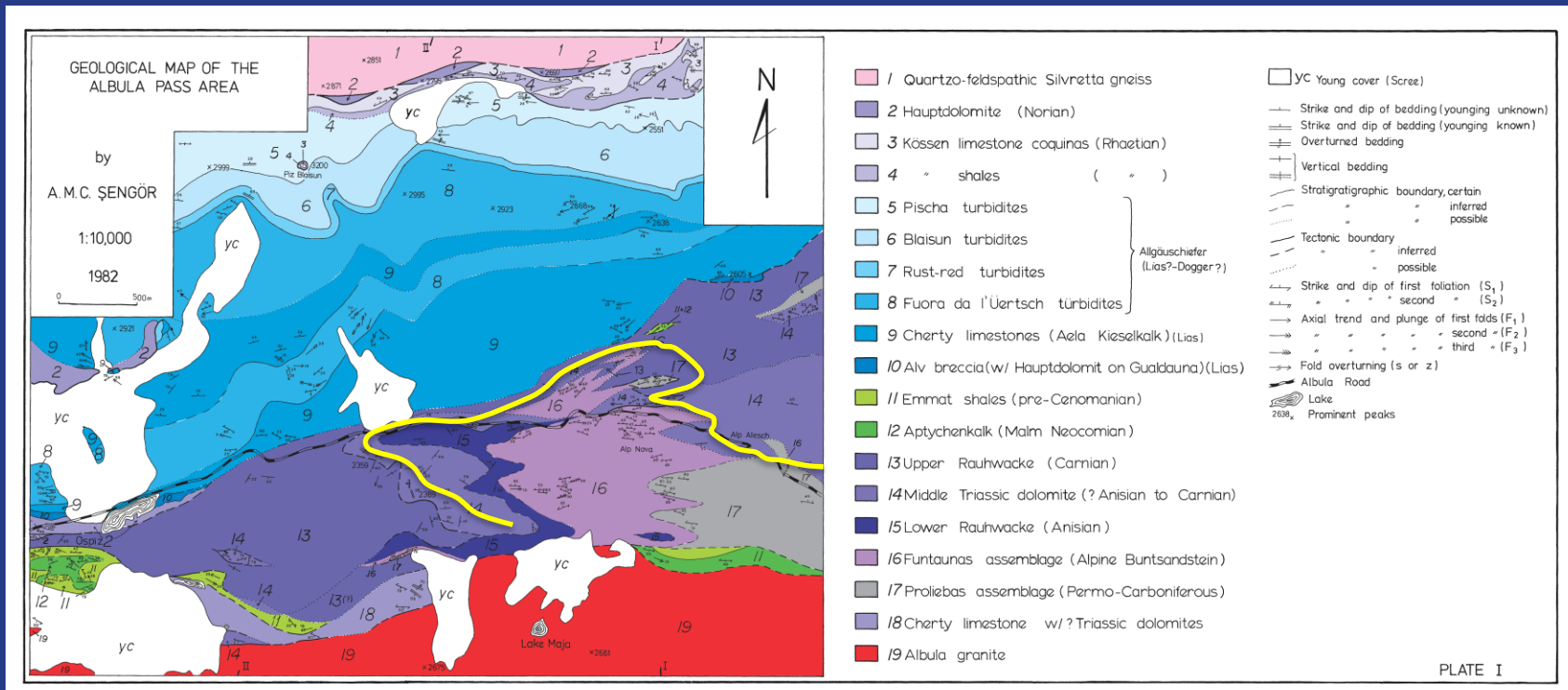


Murtel d'As-cha
Piz Blaisun
Piz Üertsch
Pass d'Alvra
Terrassas
Blaisun
Alp Nova
LAKE
Muot Ot

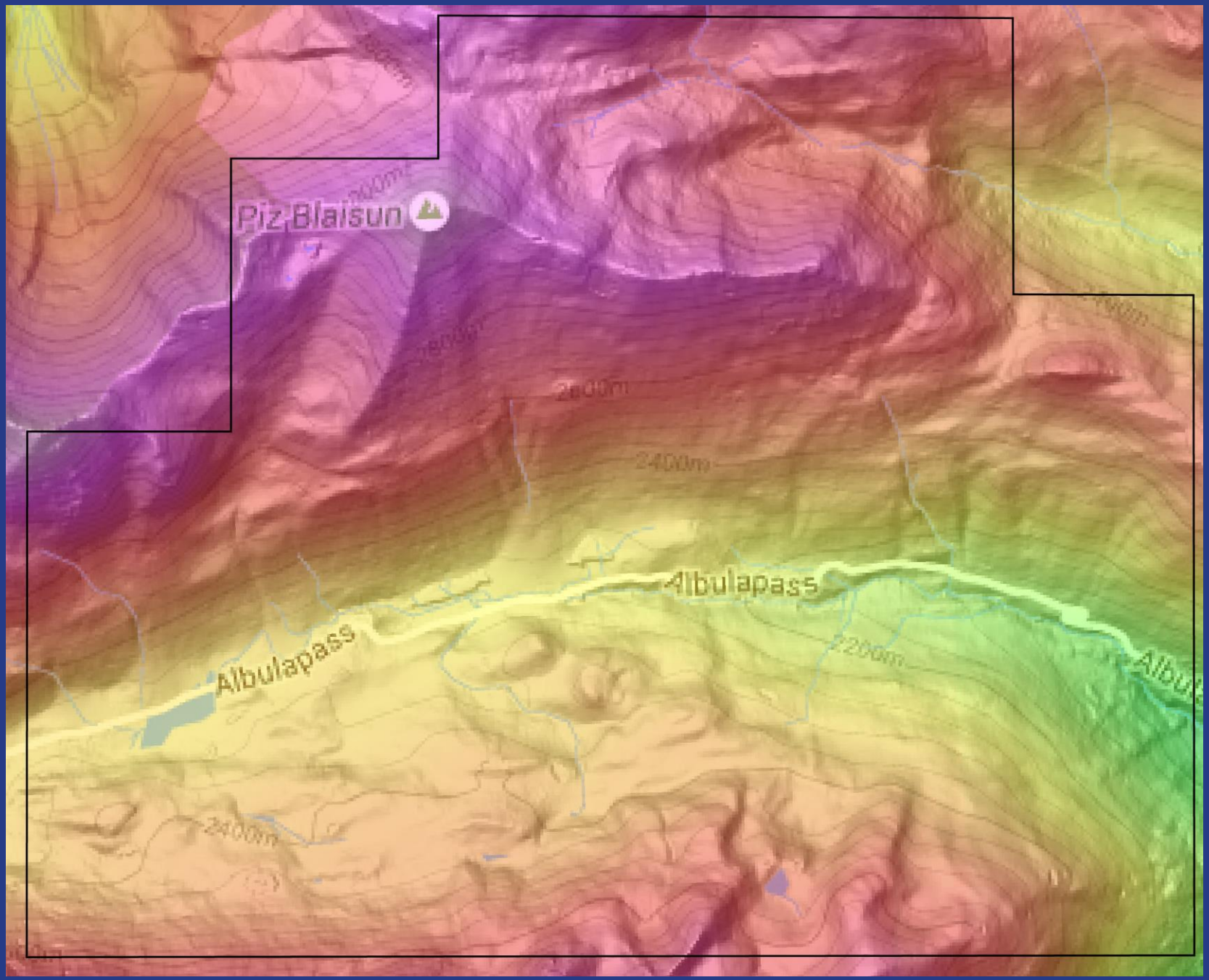


Doğu İsviçre Alplerinde Albula Geçidi jeolojik haritası

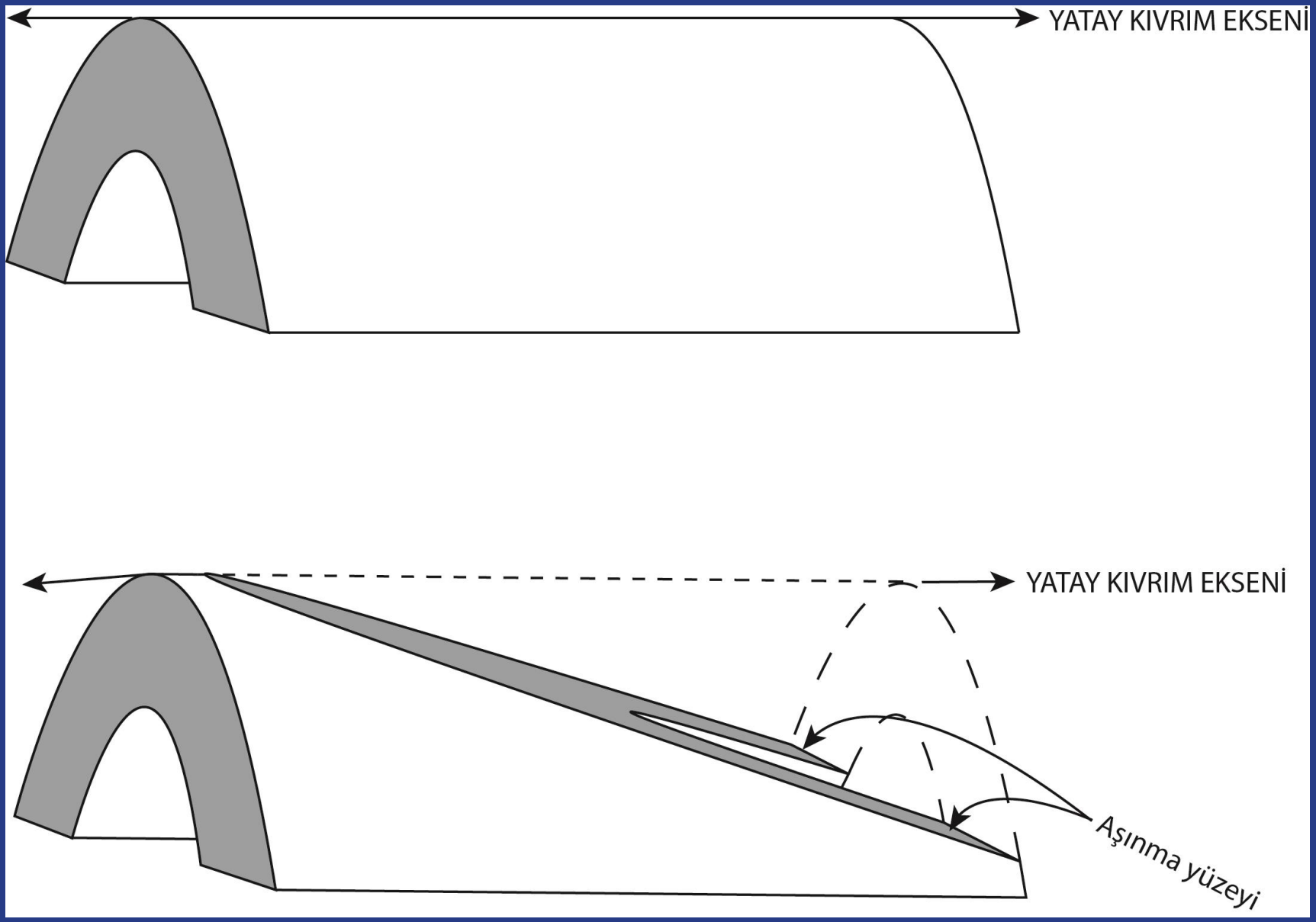

S
N
ALBULA NAPPE
SILVRETTA NAPPE (PIZ KESCH)
ERR NAPPE
(CRASTA MORA)
Sub-Silvrettan
slices
A'
A
ELA NAPPE
(PIZ UERTSCH, PIZ BLAISUN,
GUALDAUNA)
Supra-Err slices
Infra-Ela slices
(parts of the Albula Nappe)
Thrust faults
(late Cretaceous to Cainozoic)
Normal faults
(latest Triassic to Sinemurian)
0 m 500



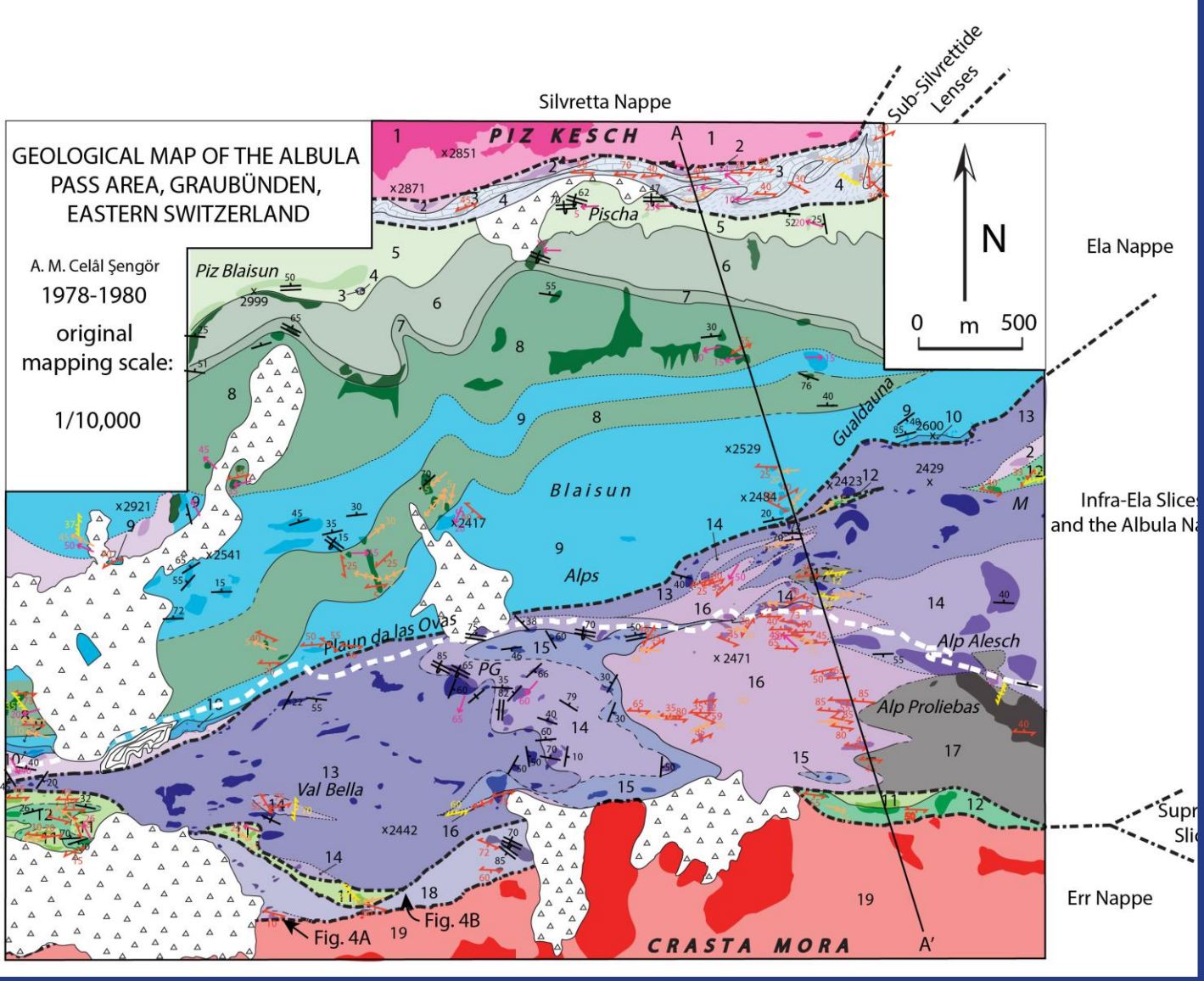
Albula Geçidi jeolojik haritasında yorumun ilk adımı: Kıvrımlanmış kıvrımı bulmak



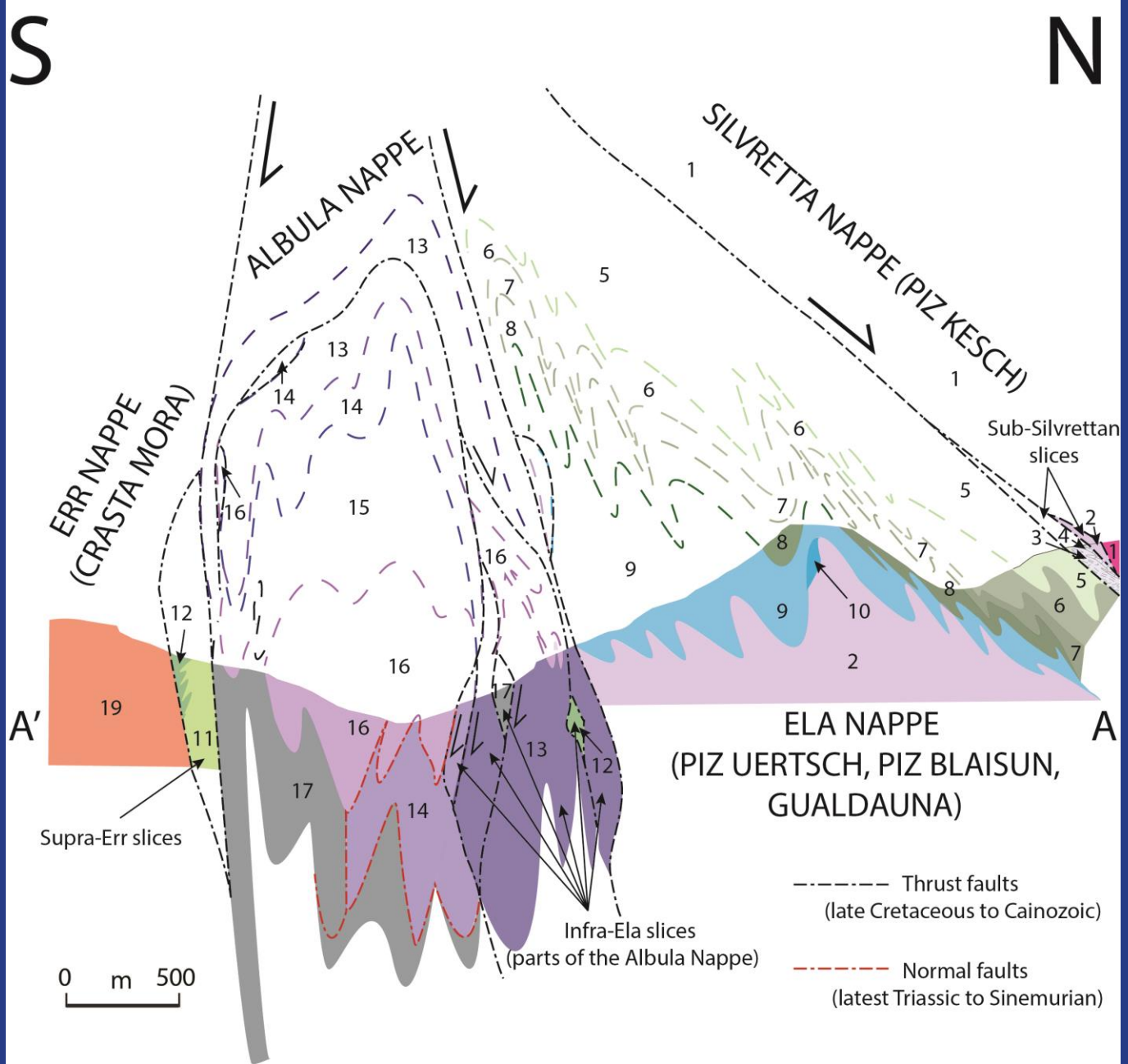
Albula Geçidinin topoğrafyası (pembe: yüksek, yeşil: alçak)

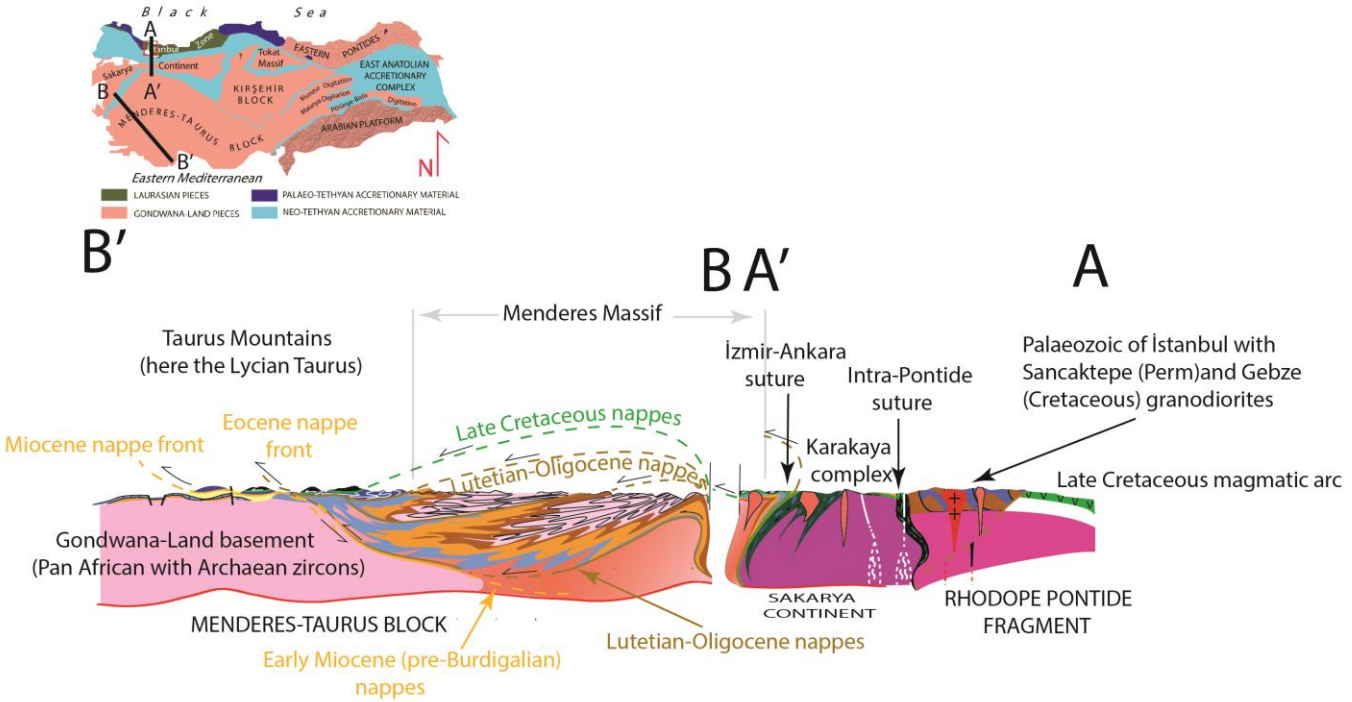


Yatay eksenlerin olduğu yerde topoğrafya eğimi kesidin ortaya çıkmasına yardımcı olabilir (Albula geçidinde olduğu gibi)



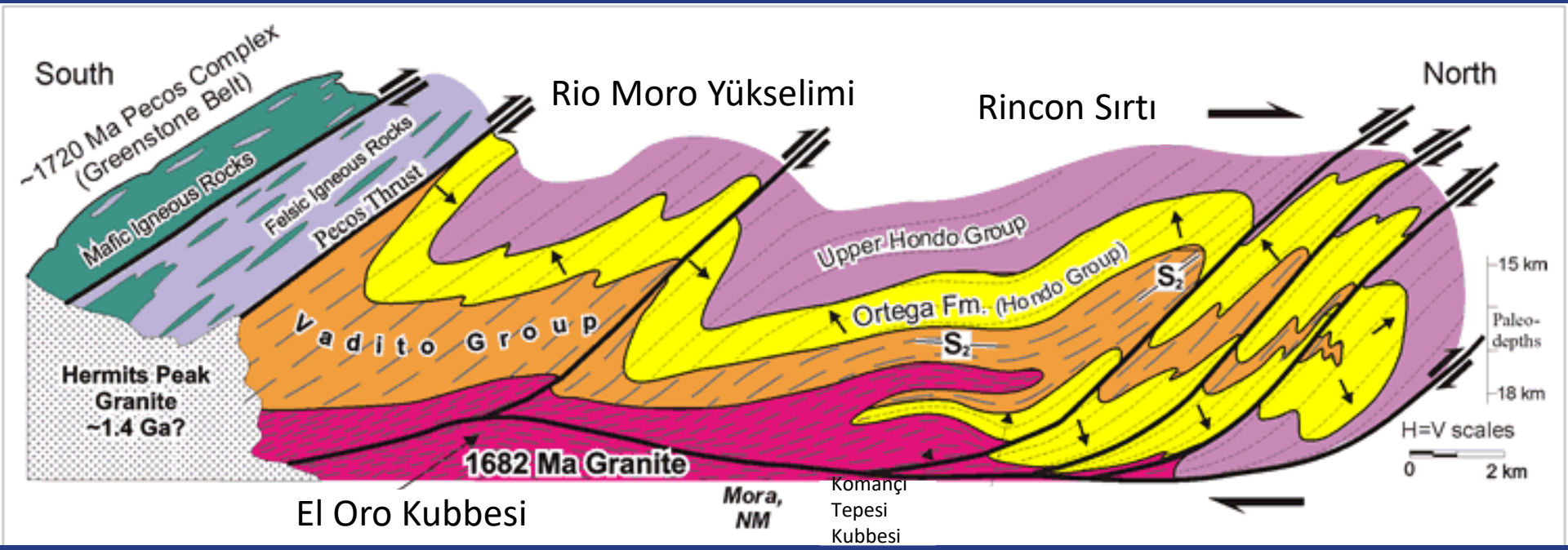
Doğu İsviçre Alplerinde Albula Geçidi jeolojik haritası


S
N
ALBULA NAPPE
SILVRETTA NAPPE (PIZ KESCH)
ERR NAPPE
(CRASTA MORA)
Sub-Silvrettan
slices
A'
A
ELA NAPPE
(PIZ UERTSCH, PIZ BLAISUN,
GUALDAUNA)
Supra-Err slices
Infra-Ela slices
(parts of the Albula Nappe)
Thrust faults
(late Cretaceous to Cainozoic)
Normal faults
(latest Triassic to Sinemurian)
0 m 500



Batı Türkiye’de Menderes Masifi içerisinde dev birinci tür naplar

Rincon Silsilesi, New Mexico, ABD



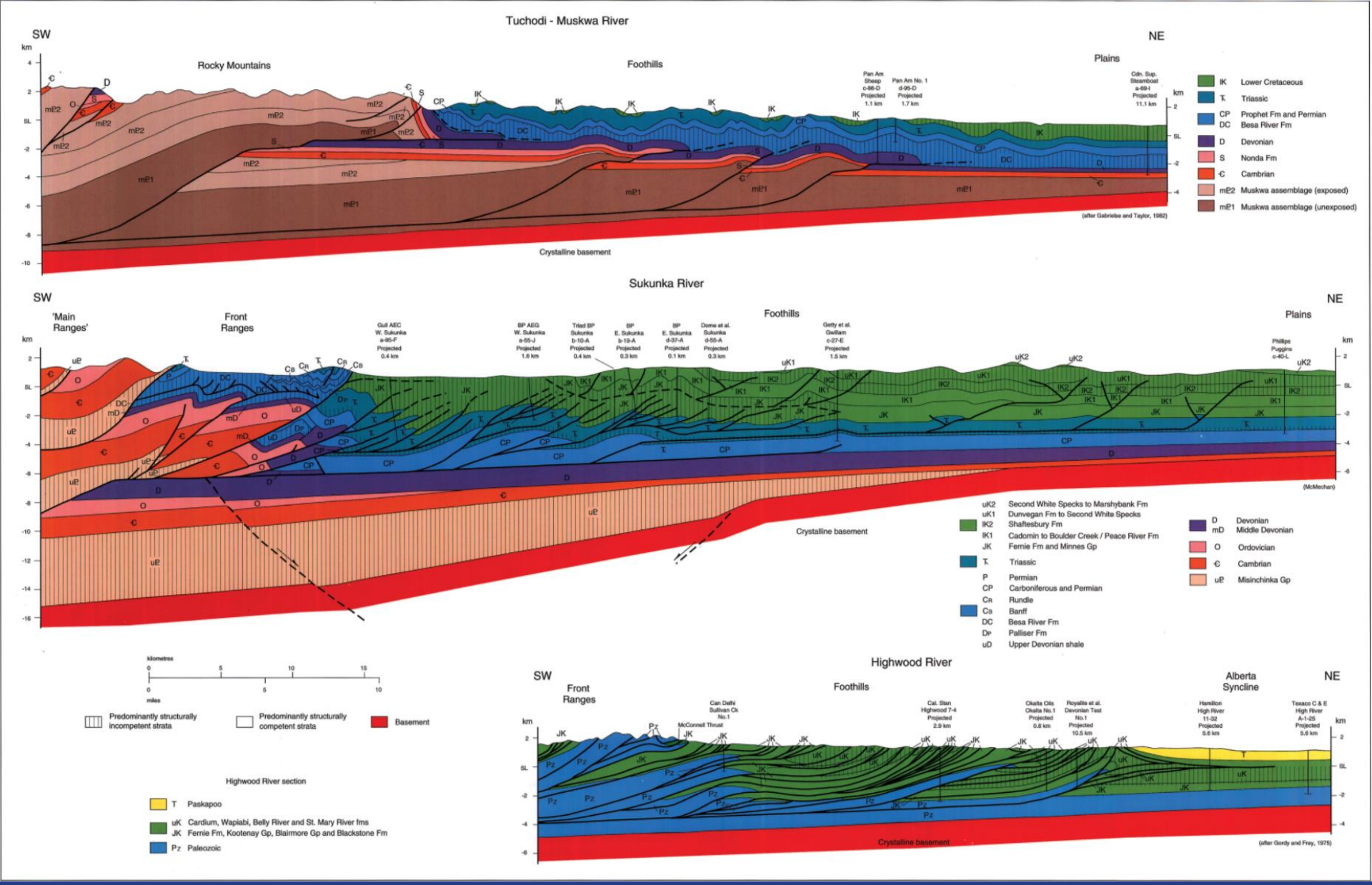
Vadito Grubu: Metabazalt, metariyolit, pelitik şist, kuvarsit ve metakonglomera

Ortega Formasyonu: Çapraz Tabakalı Kuvarsit

Hondo Grubu: Şist

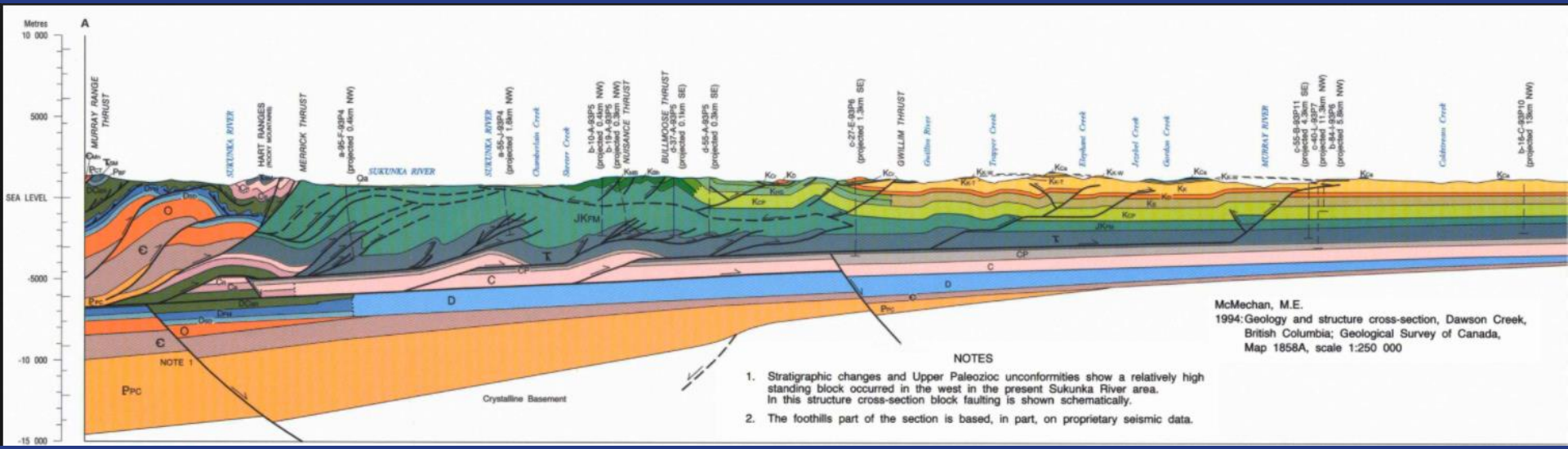
Birinci tip bir nap ve onu dilimlemiş olan ikinci tip naplar

KANADA KAYALIK DAĞLARI

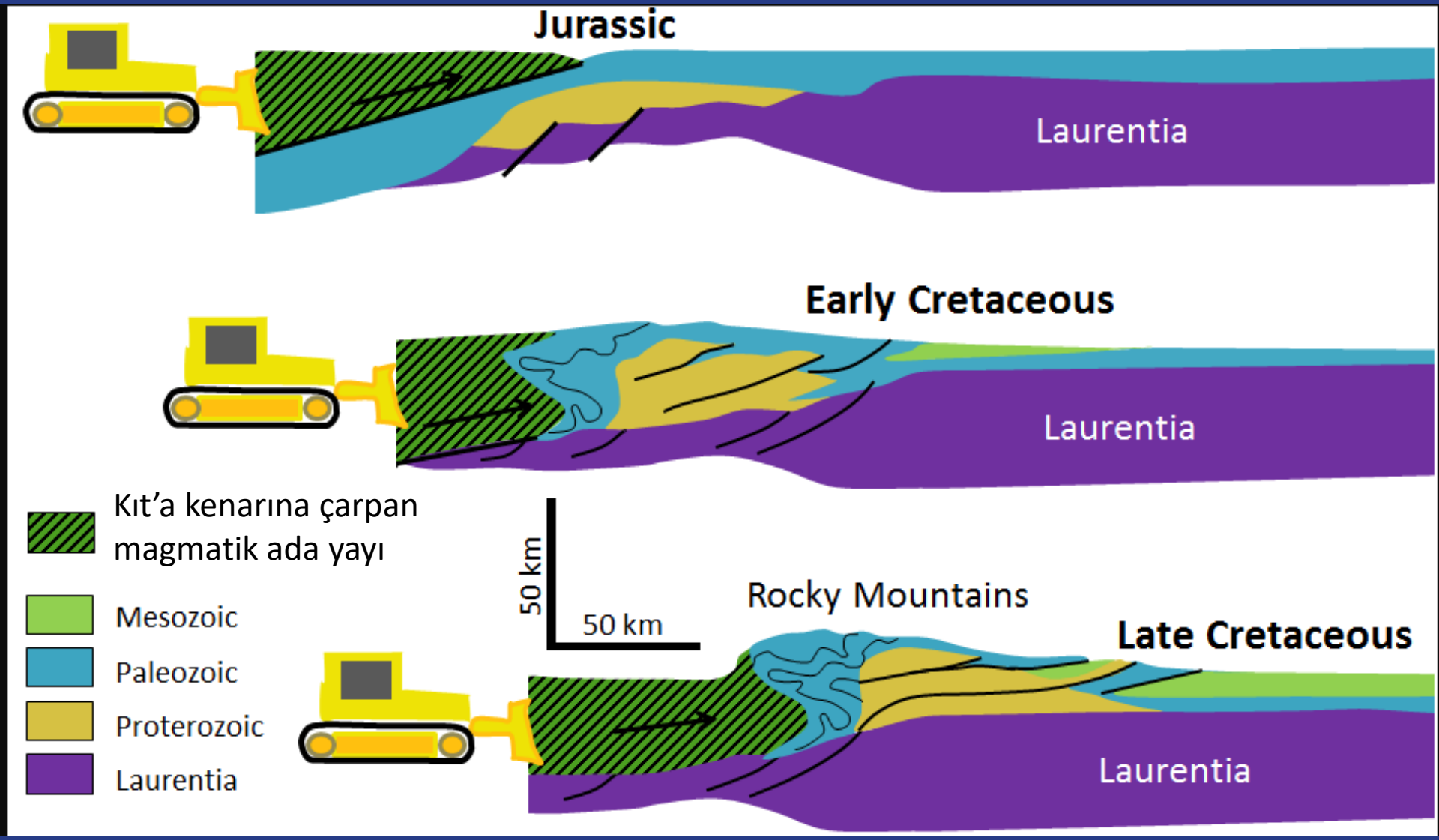


KANADA KAYALIK DAĞLARI ARDÜLKE KENAR KIVRIM VE BİNDİRME KUŞAĞI

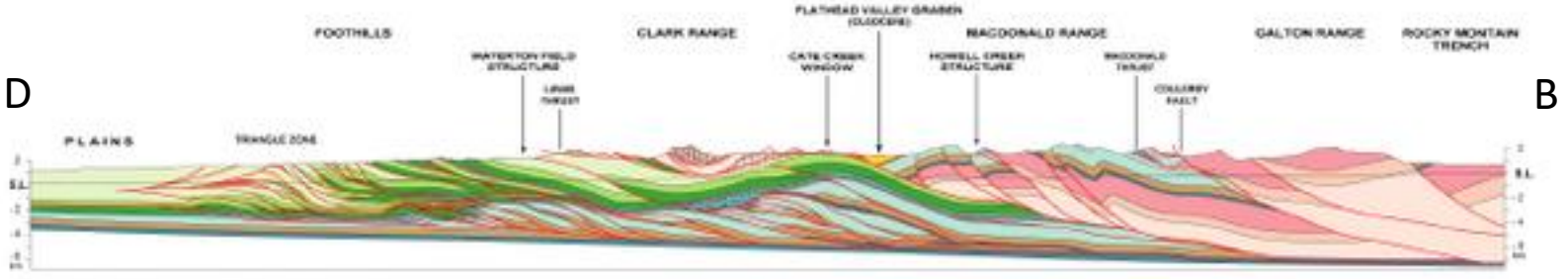
(Buradaki napların hemen hepsinin ikinci tür nap olduğuna dikkat ediniz)



Kanada Kayalık Dağlarından Dawson deresi boyunca alınmış bir başka kesit



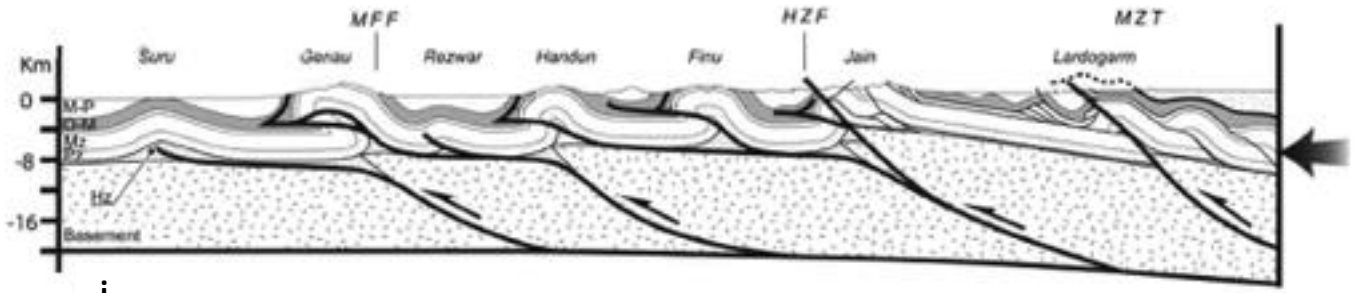
Kanada Kayalık Dağlarındaki kısalmanın çok şematik izahı



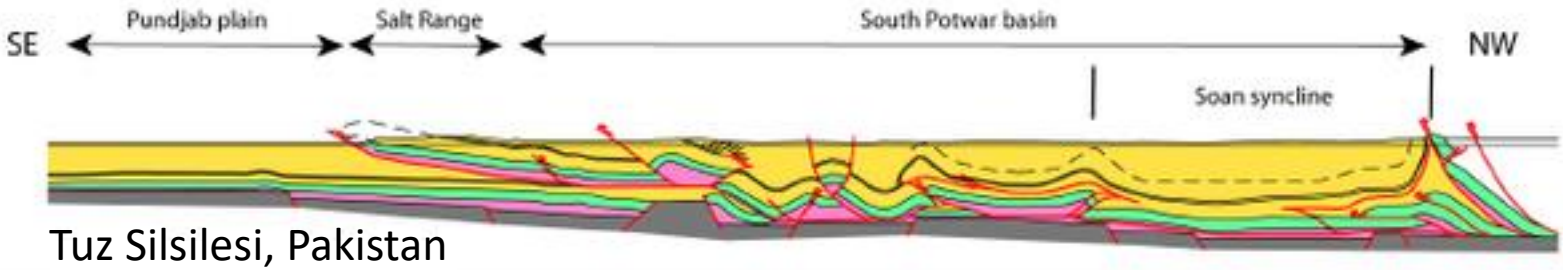
Kayalık Dağlar, Kanada

GB

KD

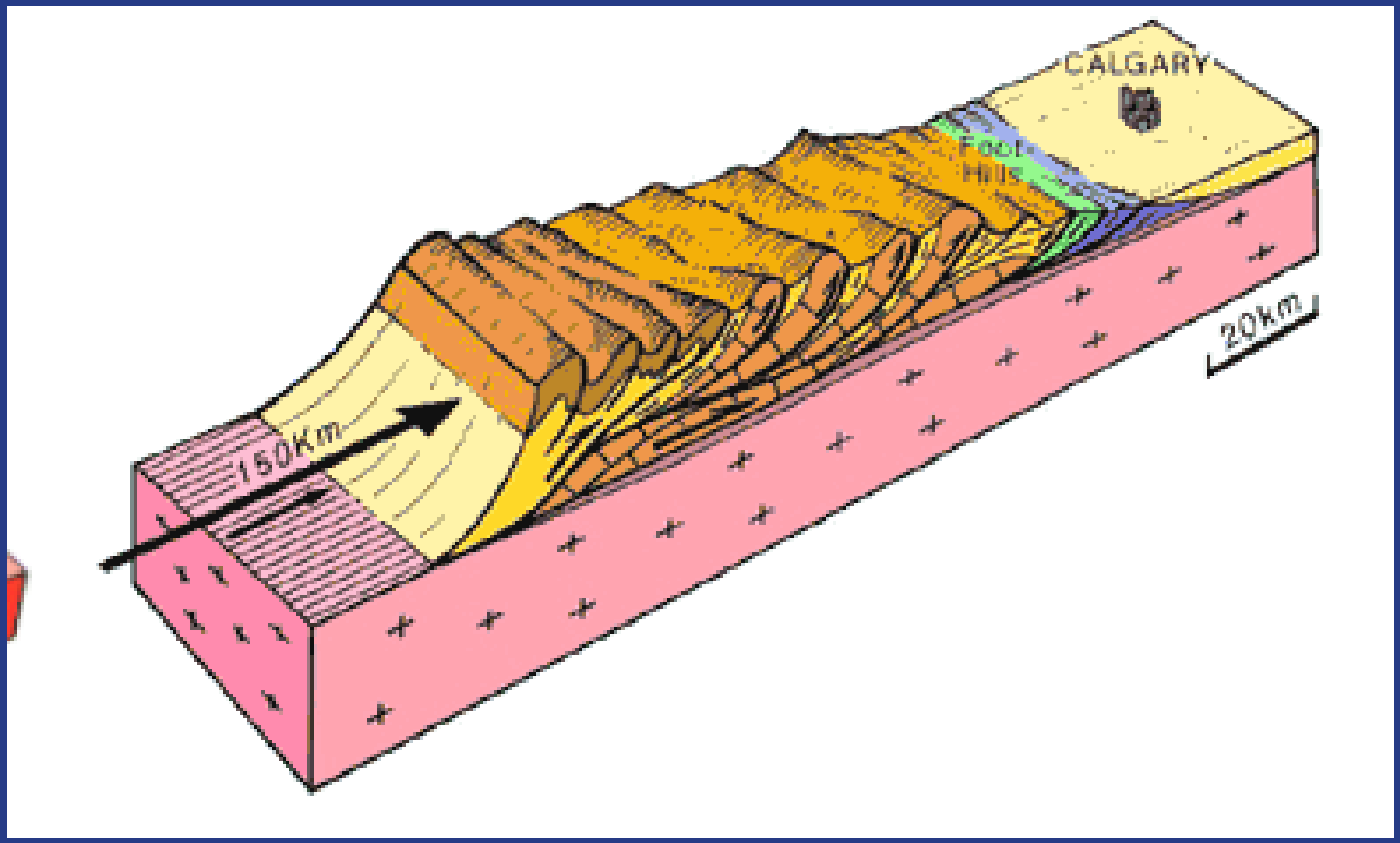


Zagros, İran

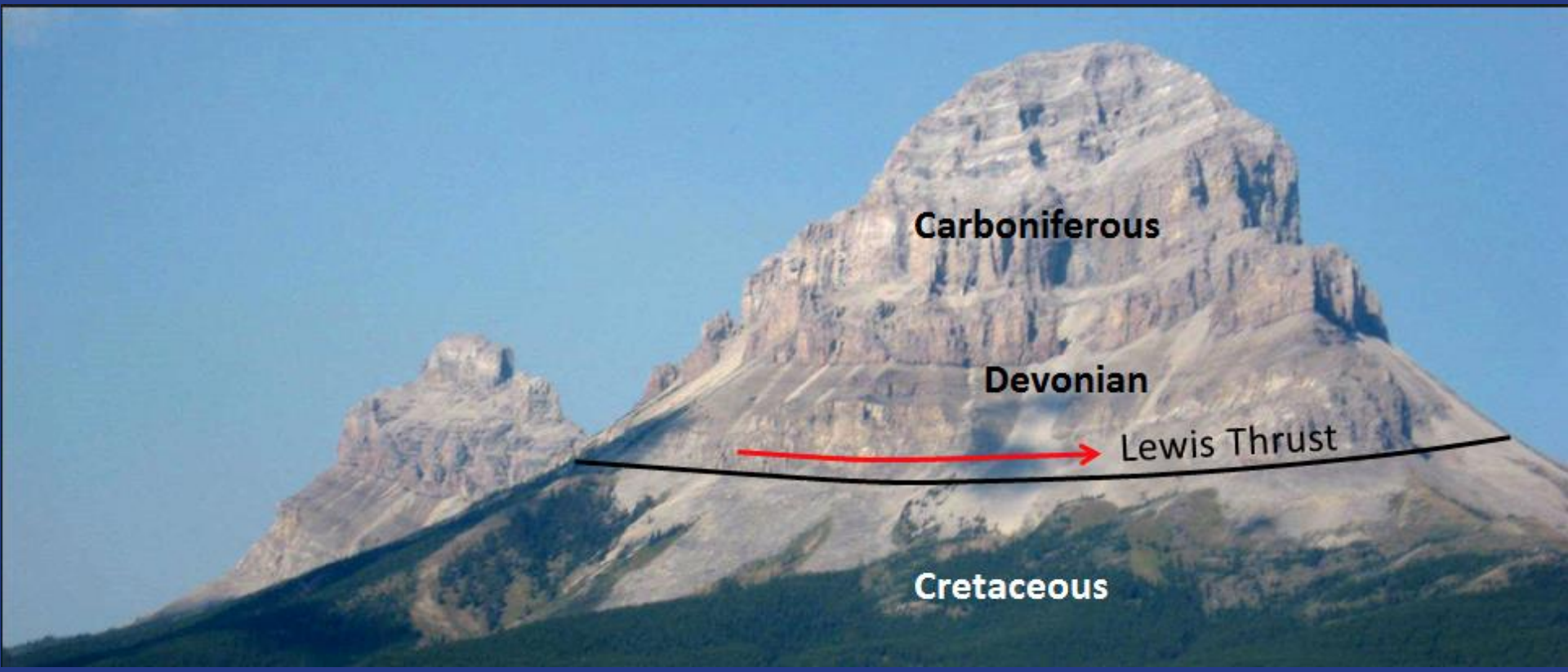


Tuz Silsilesi, Pakistan

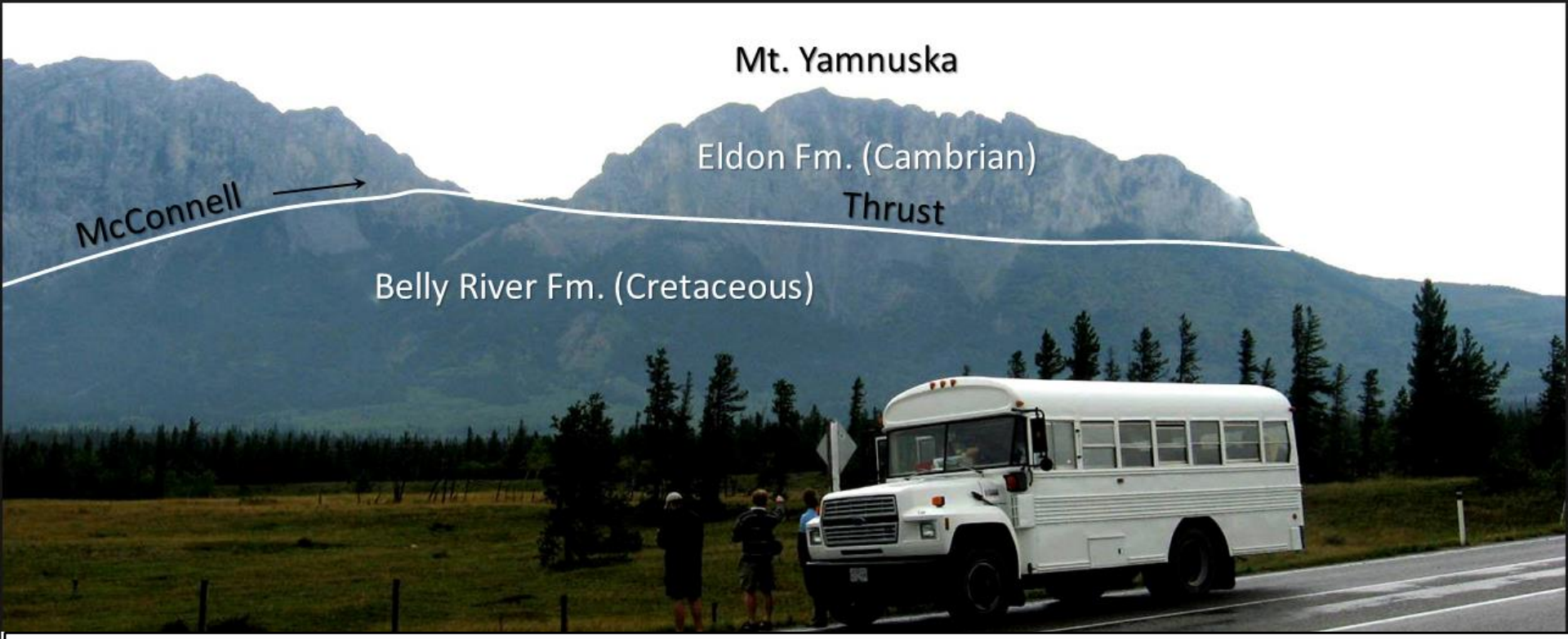
İkinci tür naplardan oluşan üç değişik kıvrım ve bindirme kuşağı

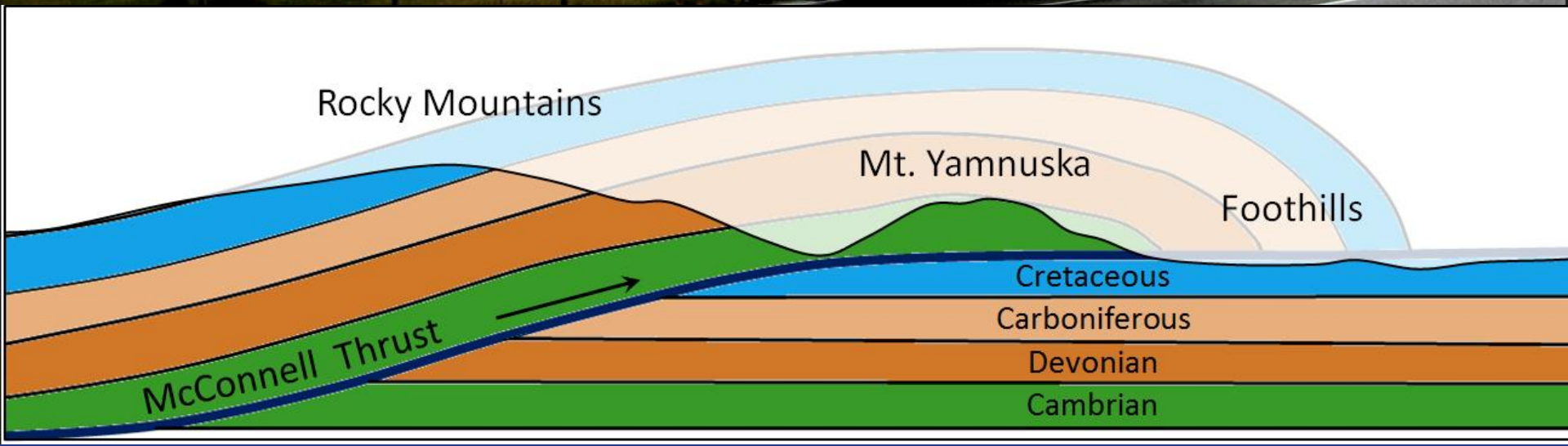


Calgary batısında Kanada Kayalık Dağlarında bindirmelerle meydana gelen daralma tektoniğinin şeması



Meşhur Lewis düşük açılı bindirme fayı, Kanada Kayalık dağları

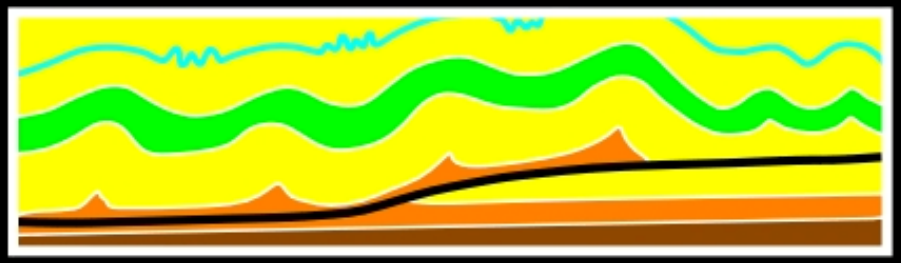




McConnell Biindirme Fayı, Kanada Kayalık Dağları

Kanada’nın Kayalık Dağlarının güney kesiminde görülen kurtulma fayı tipleri

Eşmerkezli kıvrımlı kurtulma



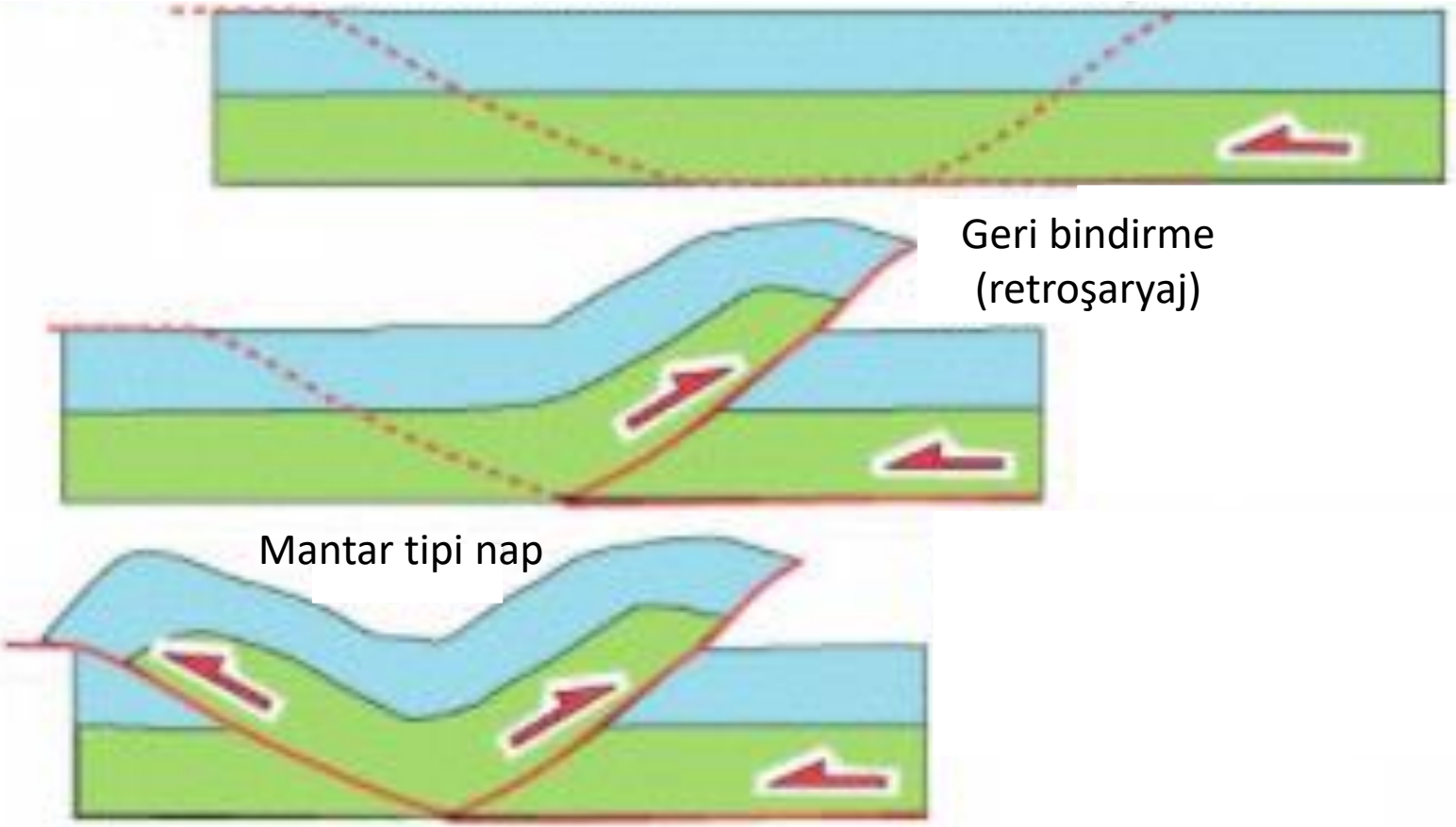
Cephe kıvrımlı kurtulma

no scale

Taban faylı kurtulma

ÖNÜLKE
(FORLAND)

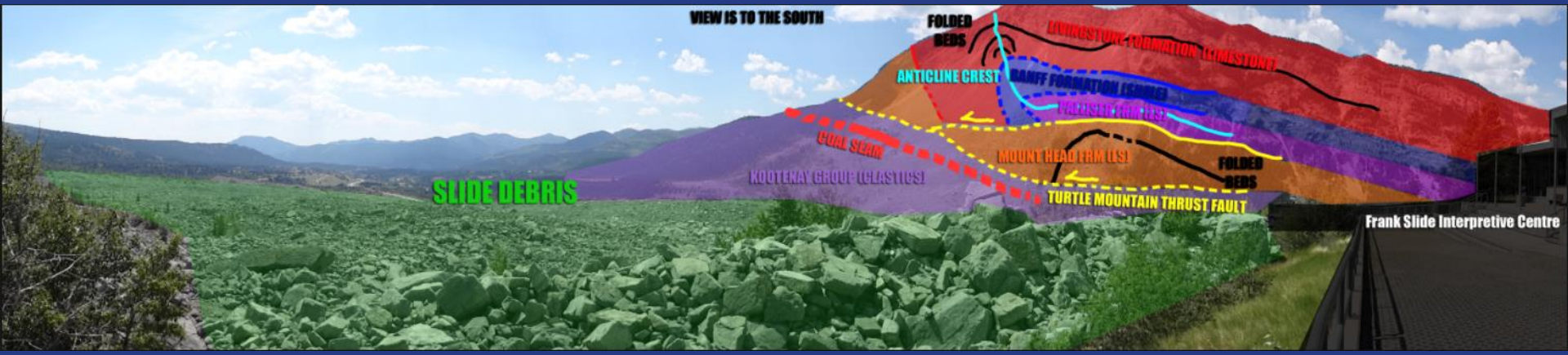
ARDÜLKE
(HİNTERLAND)



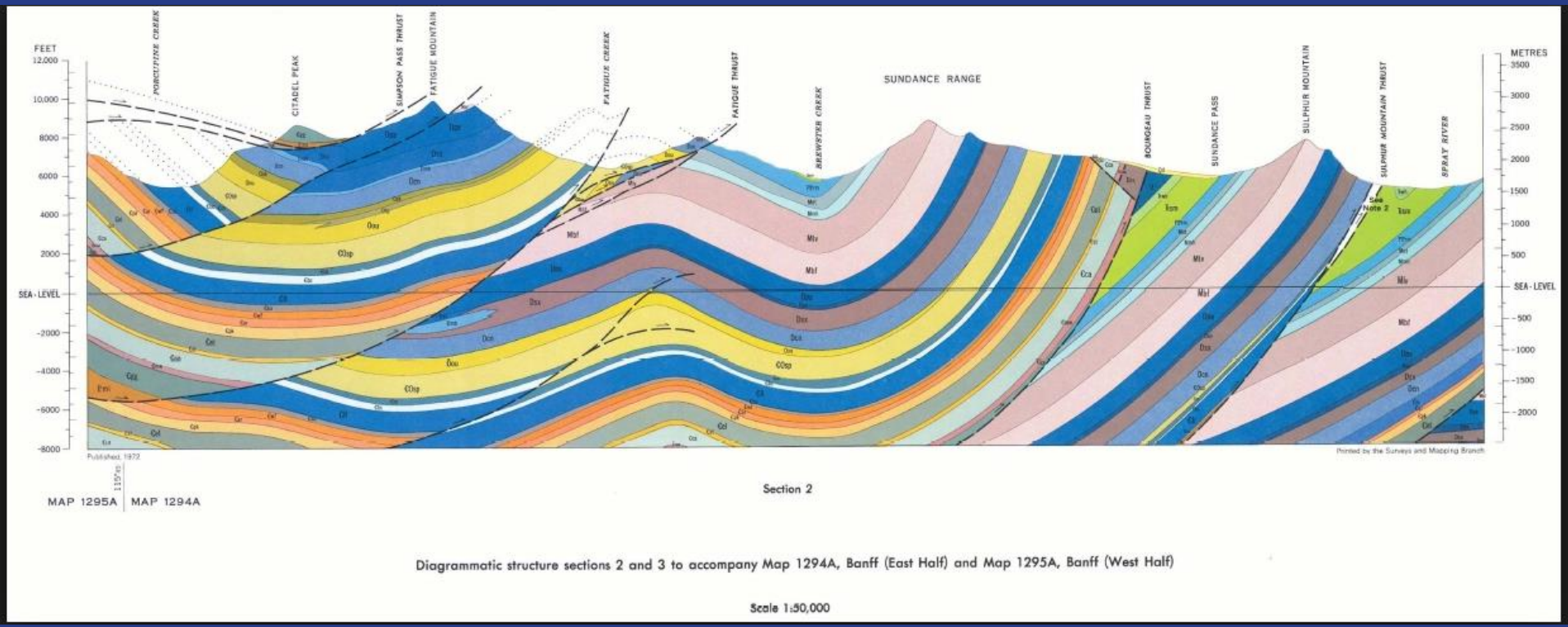
Geri bindirme
(retroşaryaj)

Mantar tipi nap

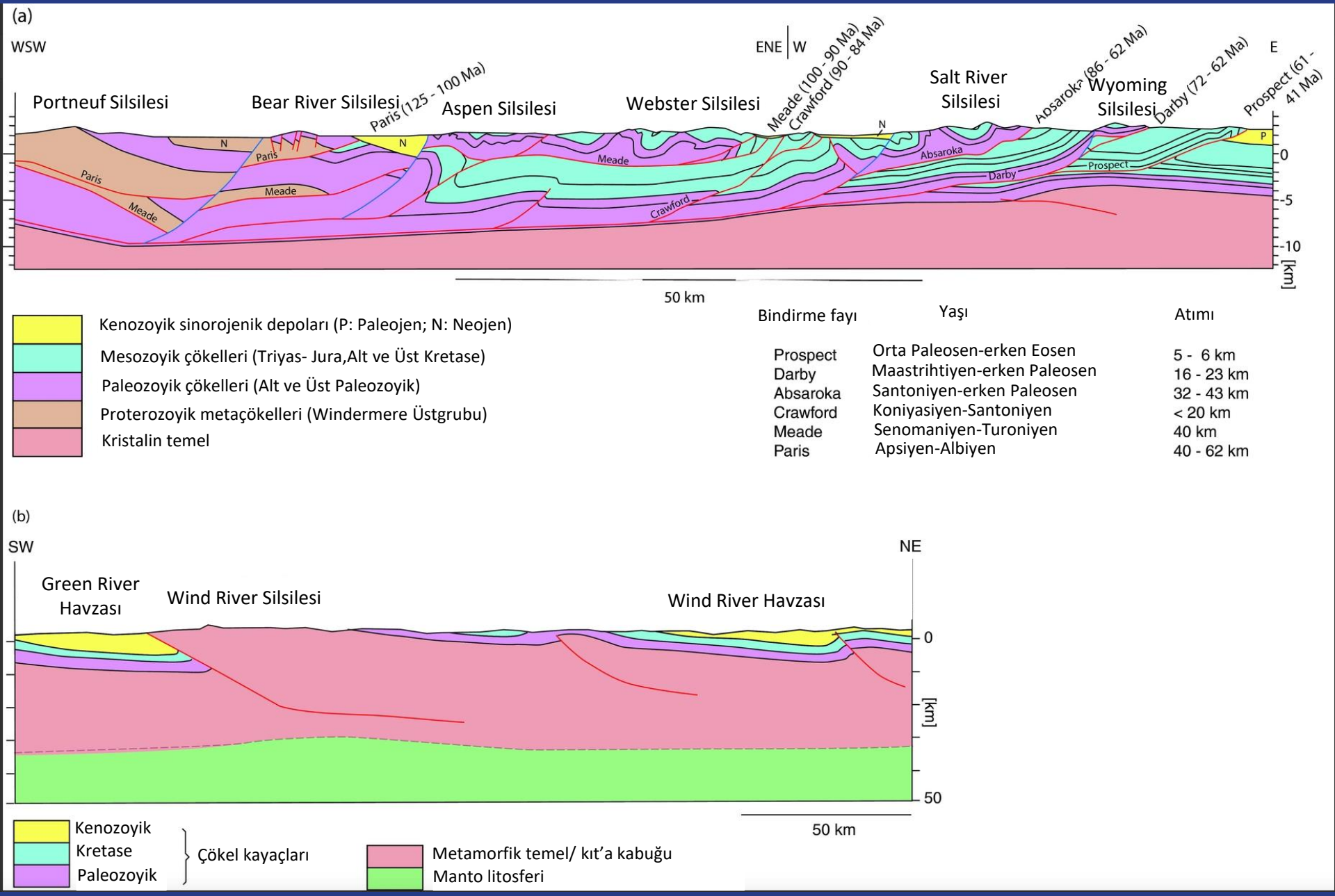
Alberta Cephe Silsilelerinde dilimlenmiş kömür depoları



Kanada Kayalık Dağlarında kıvrım-bindirme kuşağının yapısı: Northwest Territories, Kanada



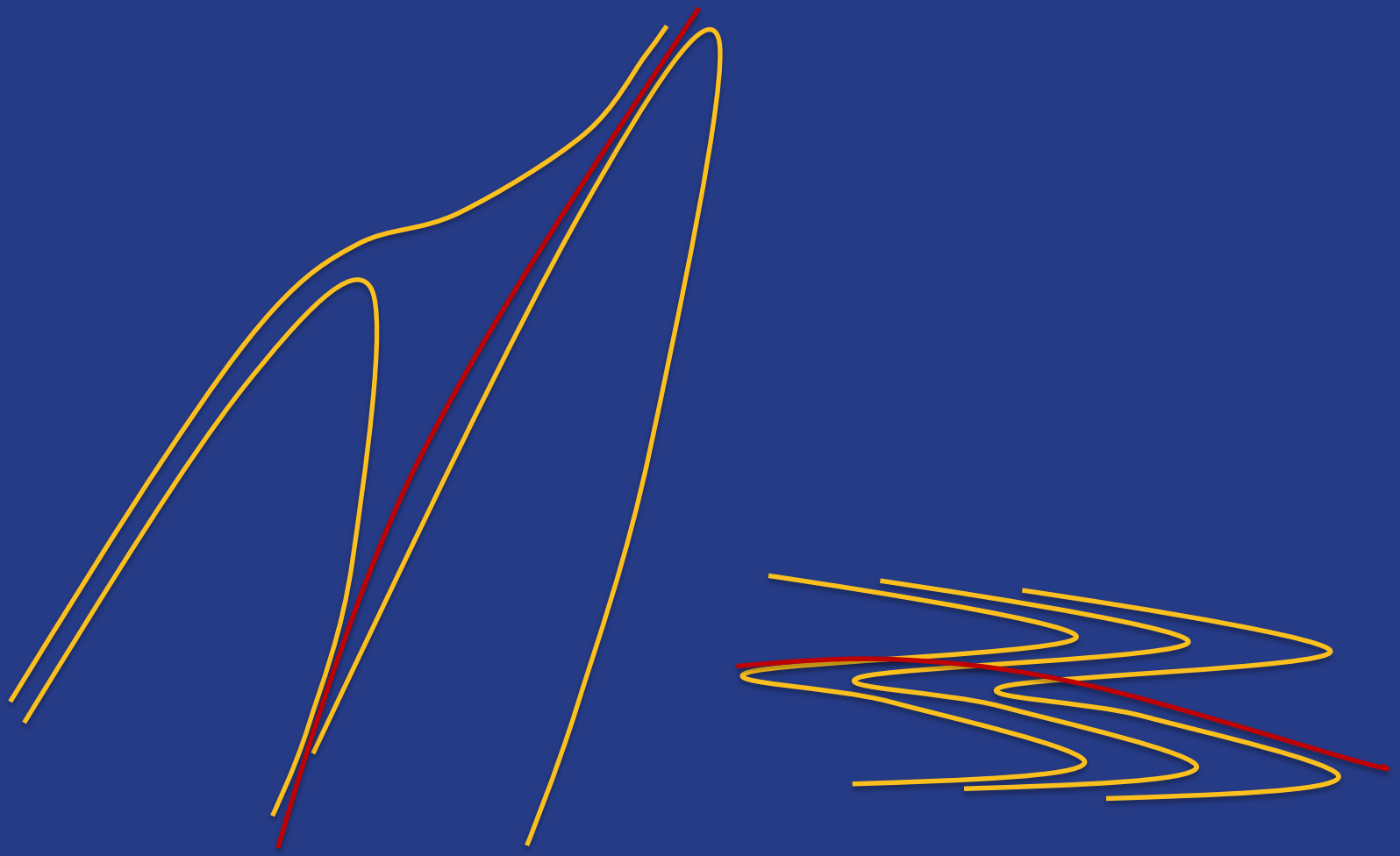
Kanada Kayalık Dağlarında, Alberta Eyaleti'nde Banff yakınlarında Kanada Kayalık Dağlarının kıvrım-bindirme kuşağının yapısı

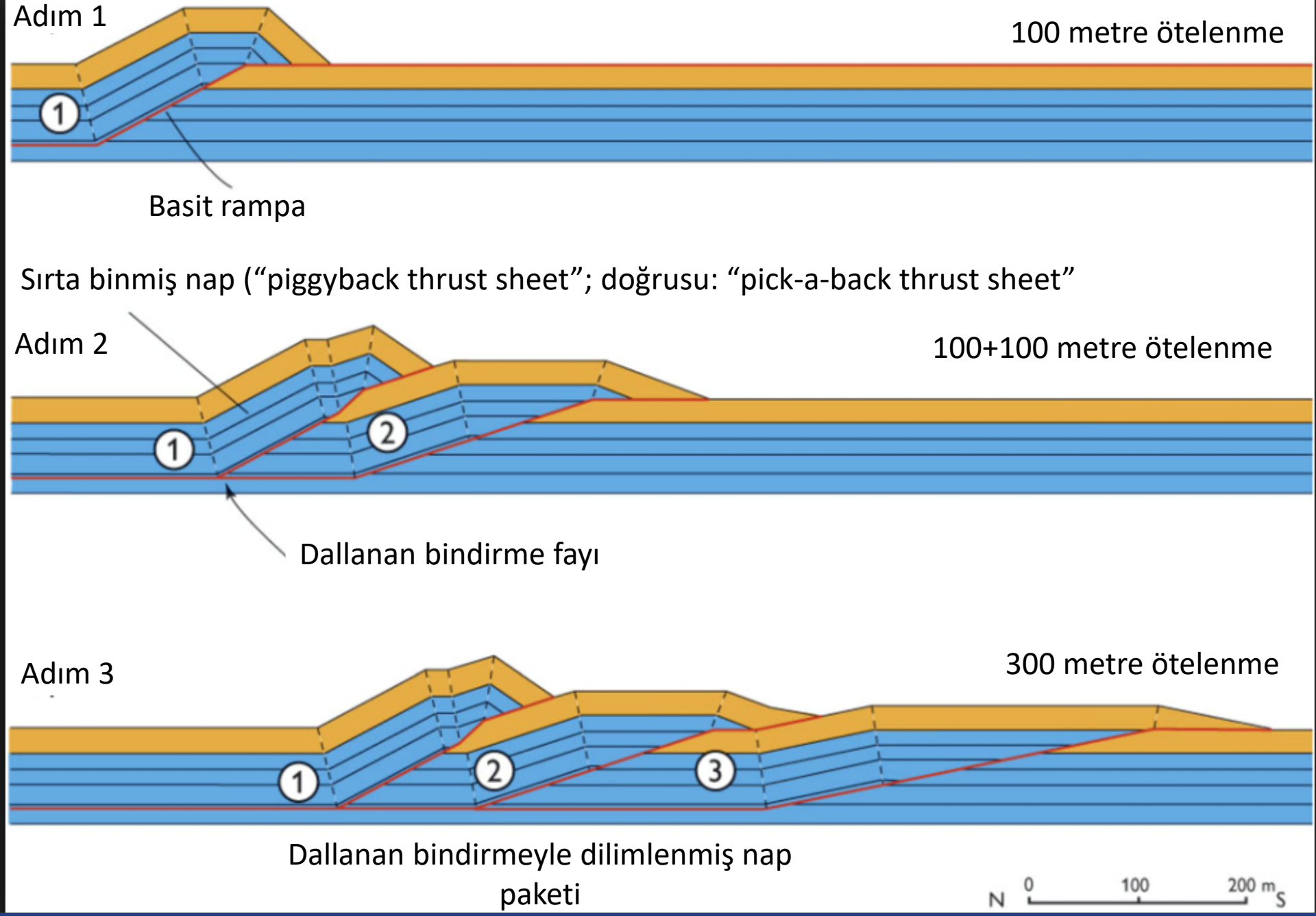


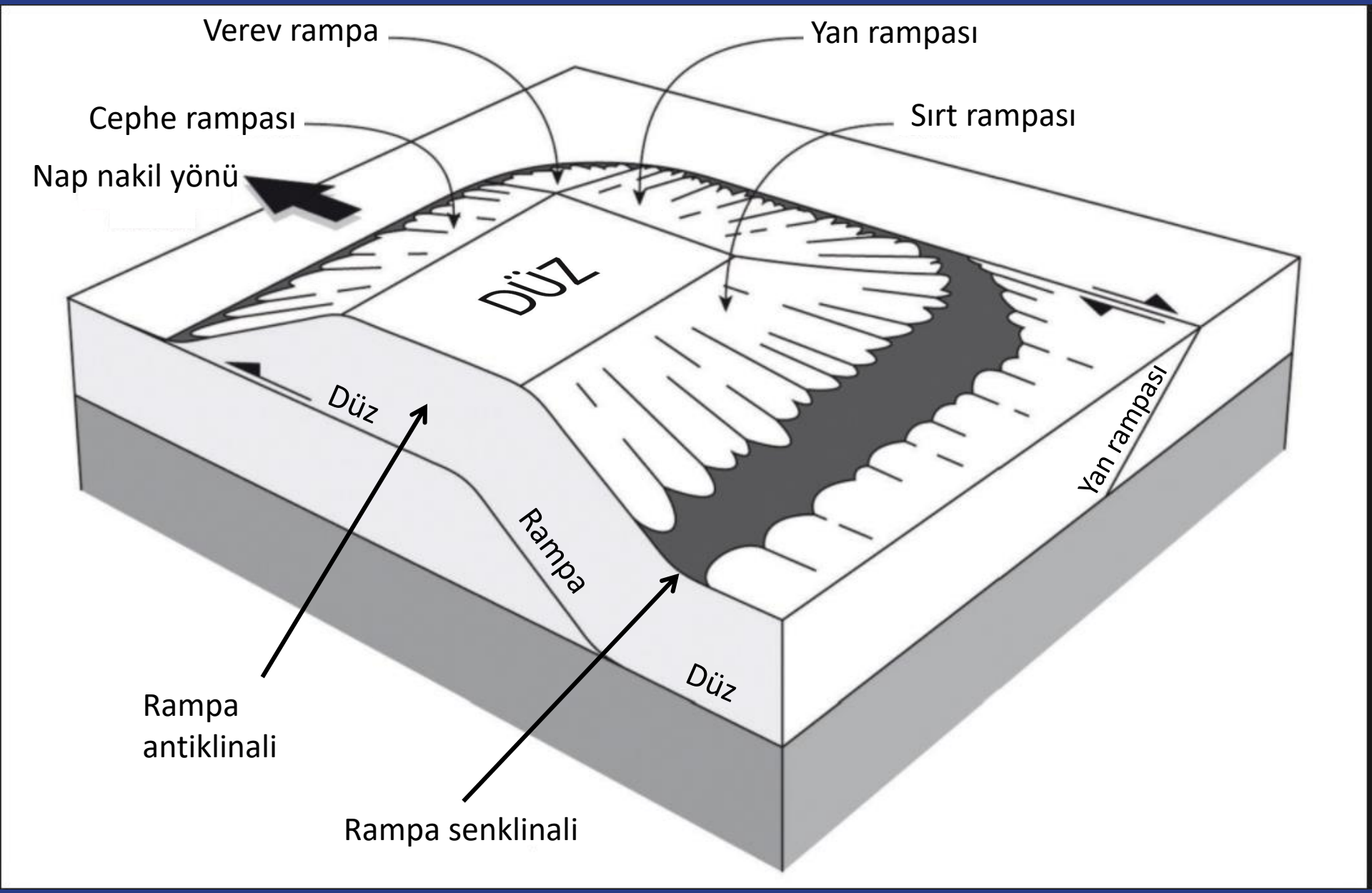
Wyoming Eyaletinde ABD Kayalık Dağları. Kanada Kayalık dağlarından farklı olarak Wind River Yükselimi örneğinde kıt'asal temel de faylanmıştır.

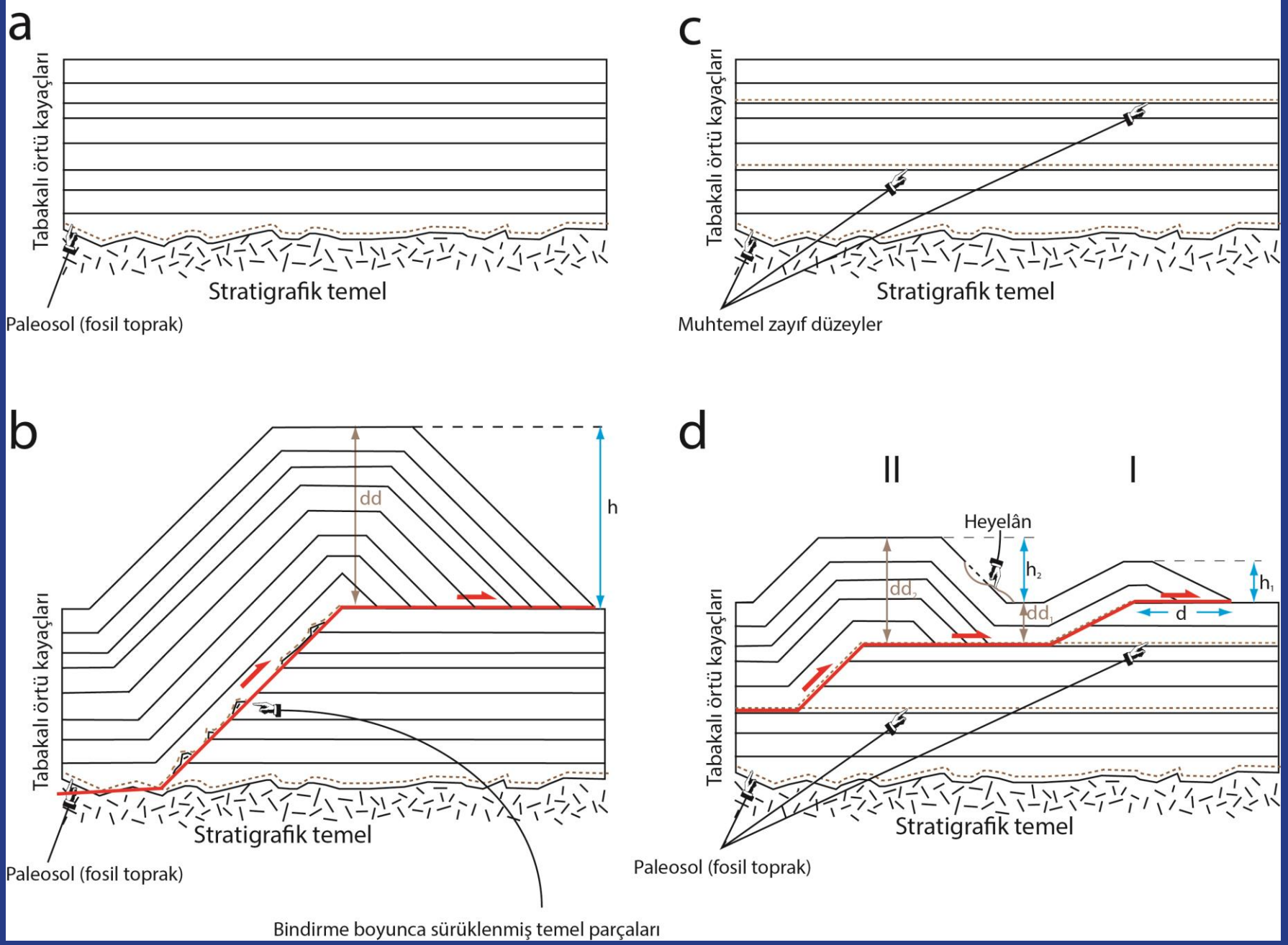

N
W
E
S
+
−


N
W
E
S

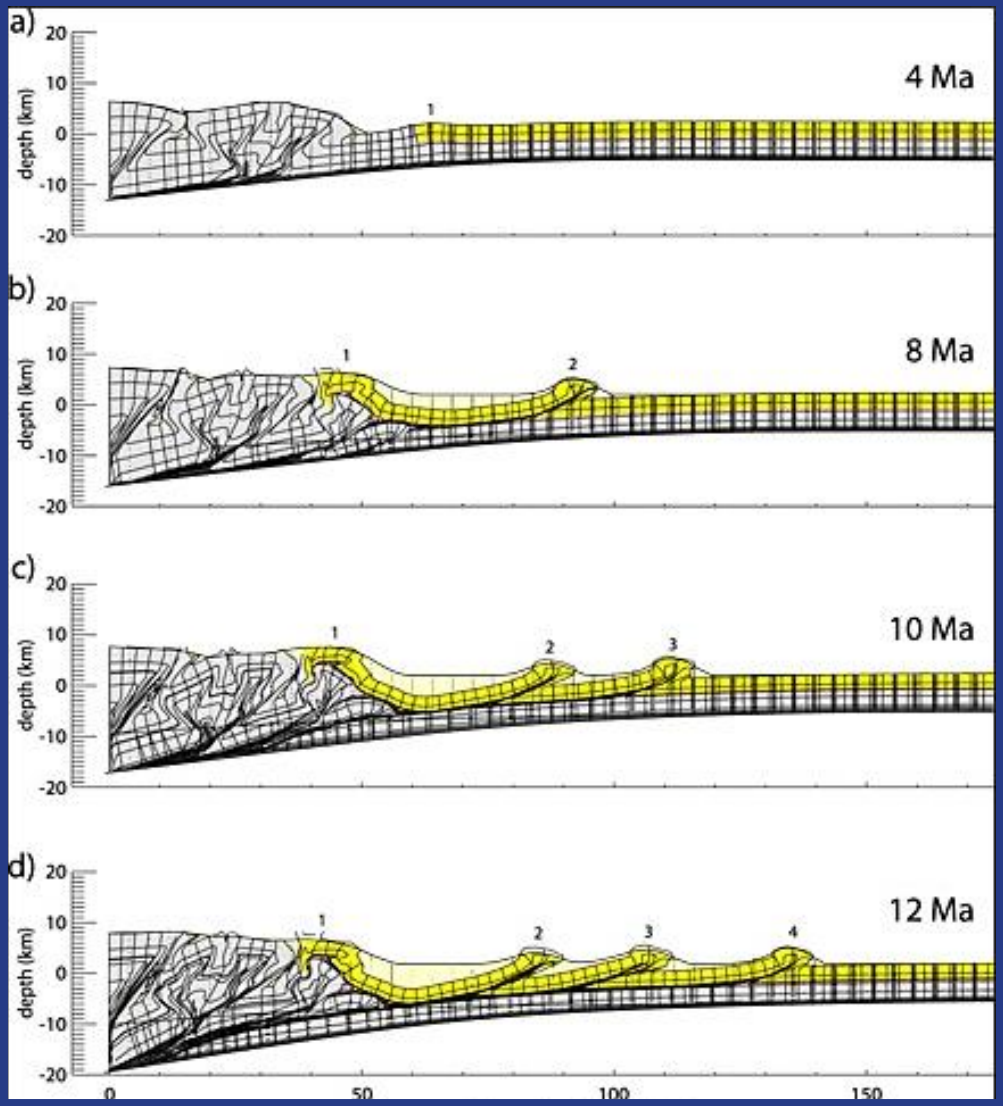



Adım 1
100 metre ötelenme
1
Basit rampa
Sırta binmiş nap (“piggyback thrust sheet”; doğrusu: “pick-a-back thrust sheet”
Adım 2
100+100 metre ötelenme
1
2
Dallanan bindirme fayı
Adım 3
300 metre ötelenme
1
2
3
Dallanan bindirmeyle dilimlenmiş nap paketi
N
0
100
200 m
S


Verev rampa
Yan rampası
Cephe rampası
Sırt rampası
Nap nakil yönü
DÜZ
Düz
Rampa
Yan rampası
Düz
Rampa antiklinali
Rampa senklinali



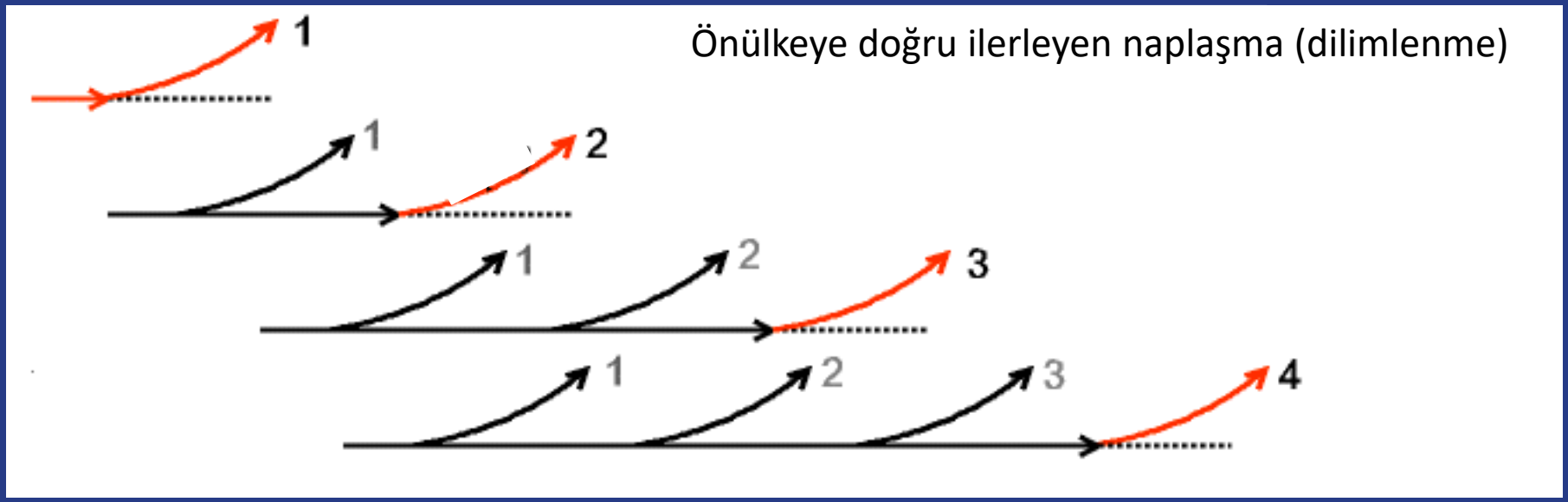
Kurtulma derinliğinin hesap edilmesi



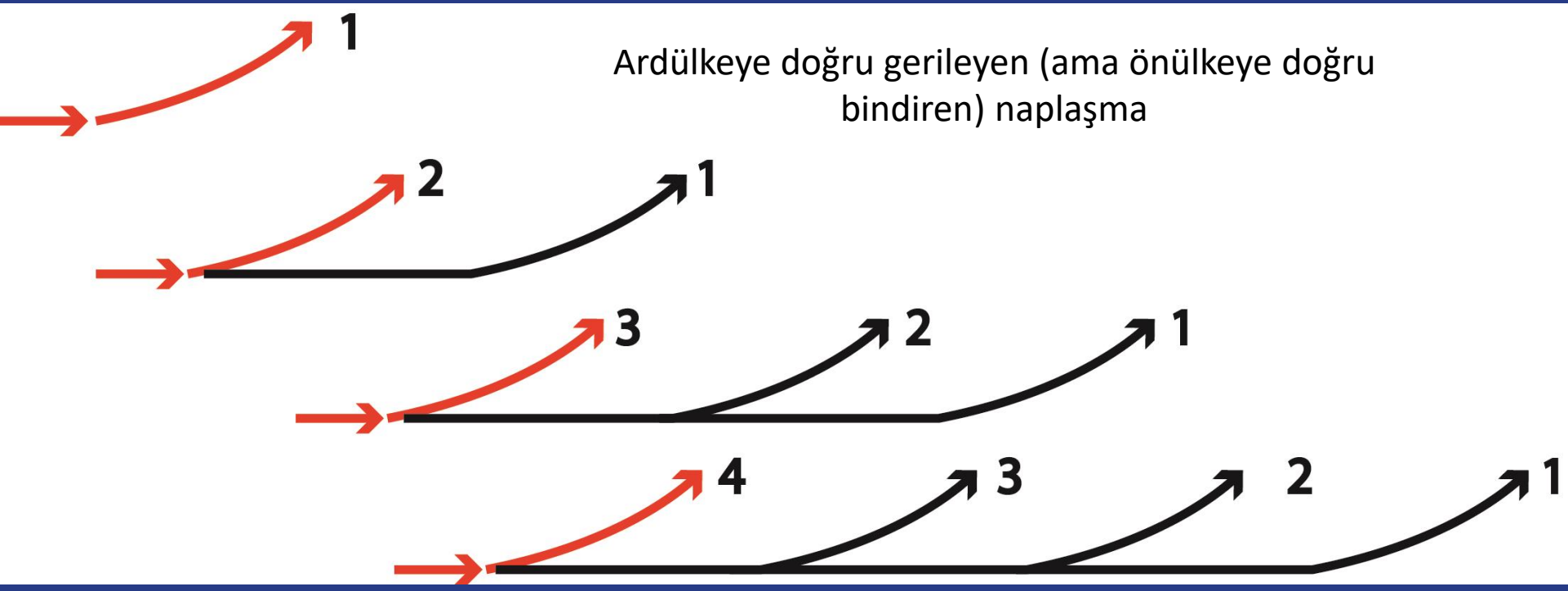
Derinlik (km)

Arka tampona olan uzaklık (km)

İlerleyen naplaşma

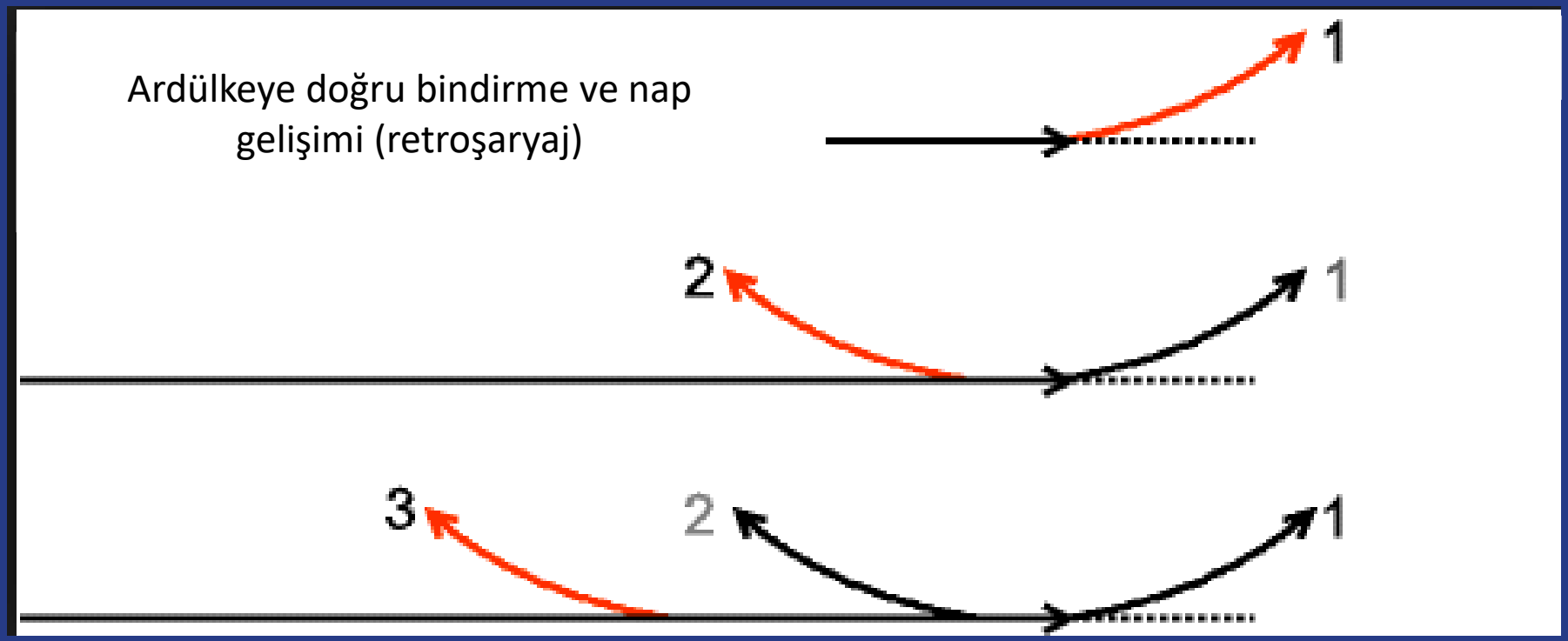


İlerleyen, önülkeye bindiren naplaşma



Ardülkeye doğru gerileyen (ama önülkeye doğru bindiren) naplaşma

Gerileyen ama gene önülkeye bindiren naplaşma

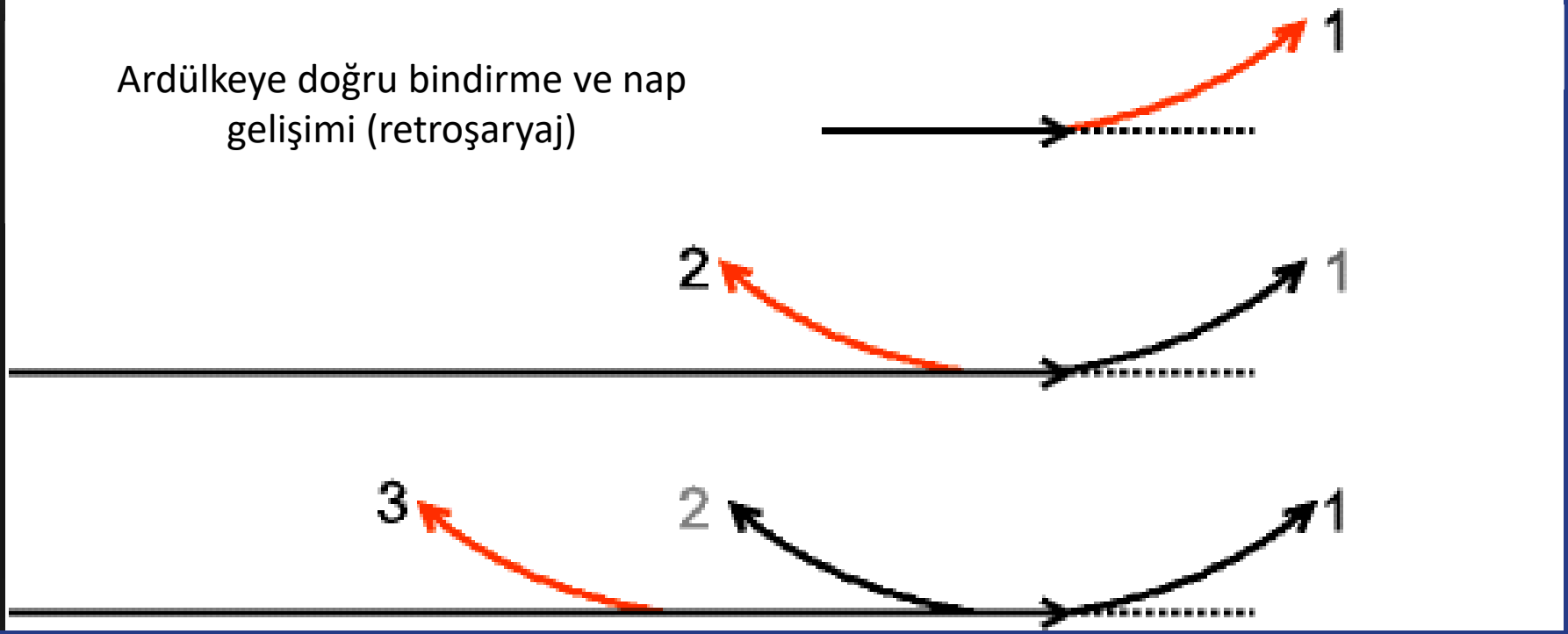


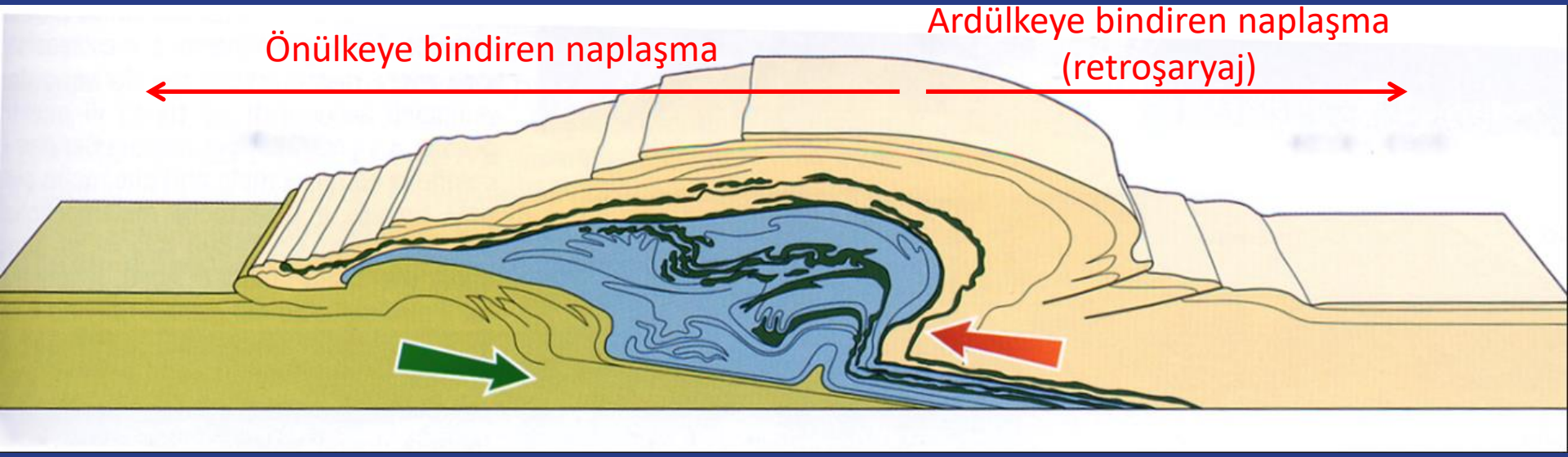
Geri bindirme (retroşaryaj) yani ardülkeye bindiren naplaşma

Ardülkeye doğru gerileyen (ama önülkeye doğru bindiren) naplaşma

BU RETROŞARYAJ (GERİ BİNDİRME) DEĞİLDİR

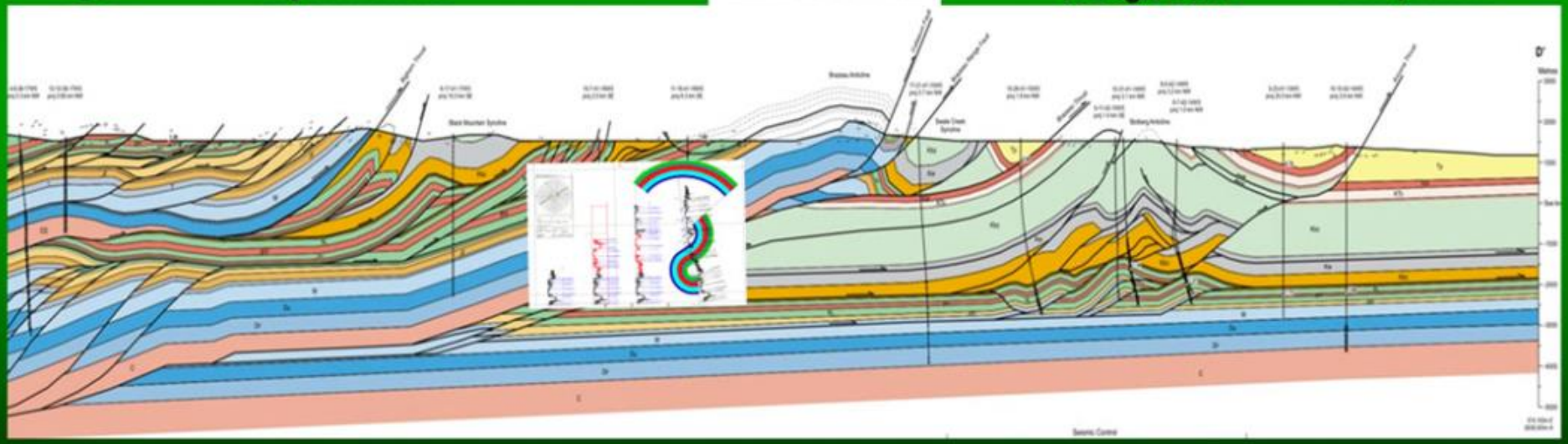
Ardülkeye doğru bindirme ve nap gelişimi (retroşaryaj)




Önülkeye bindiren naplaşma
Ardülkeye bindiren naplaşma
(retroşaryaj)

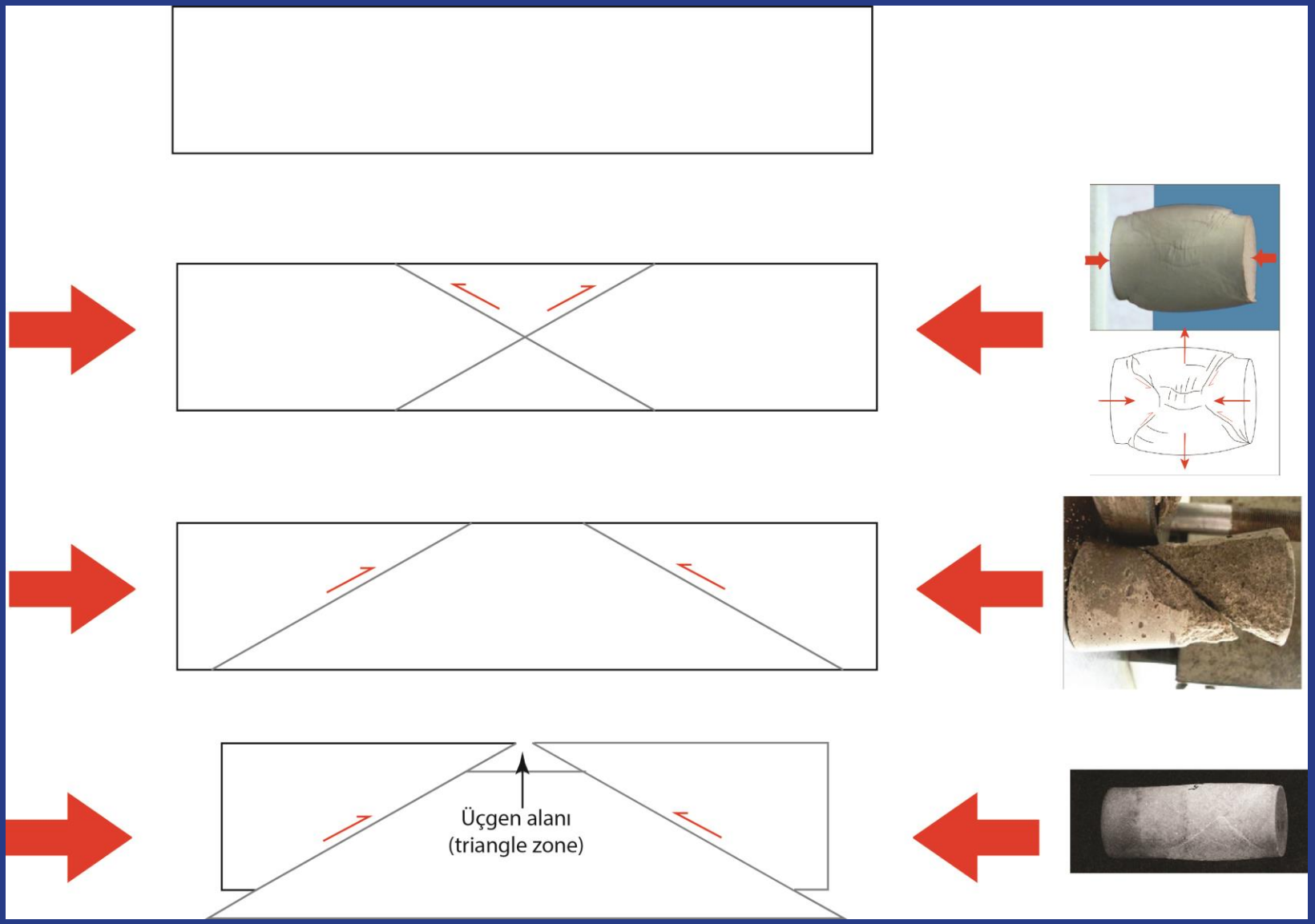
LOFF 8 long offset high intensity line

Nordegg | Bighorn thrust | Brazeau Thrust | Triangle zone | Deep basin

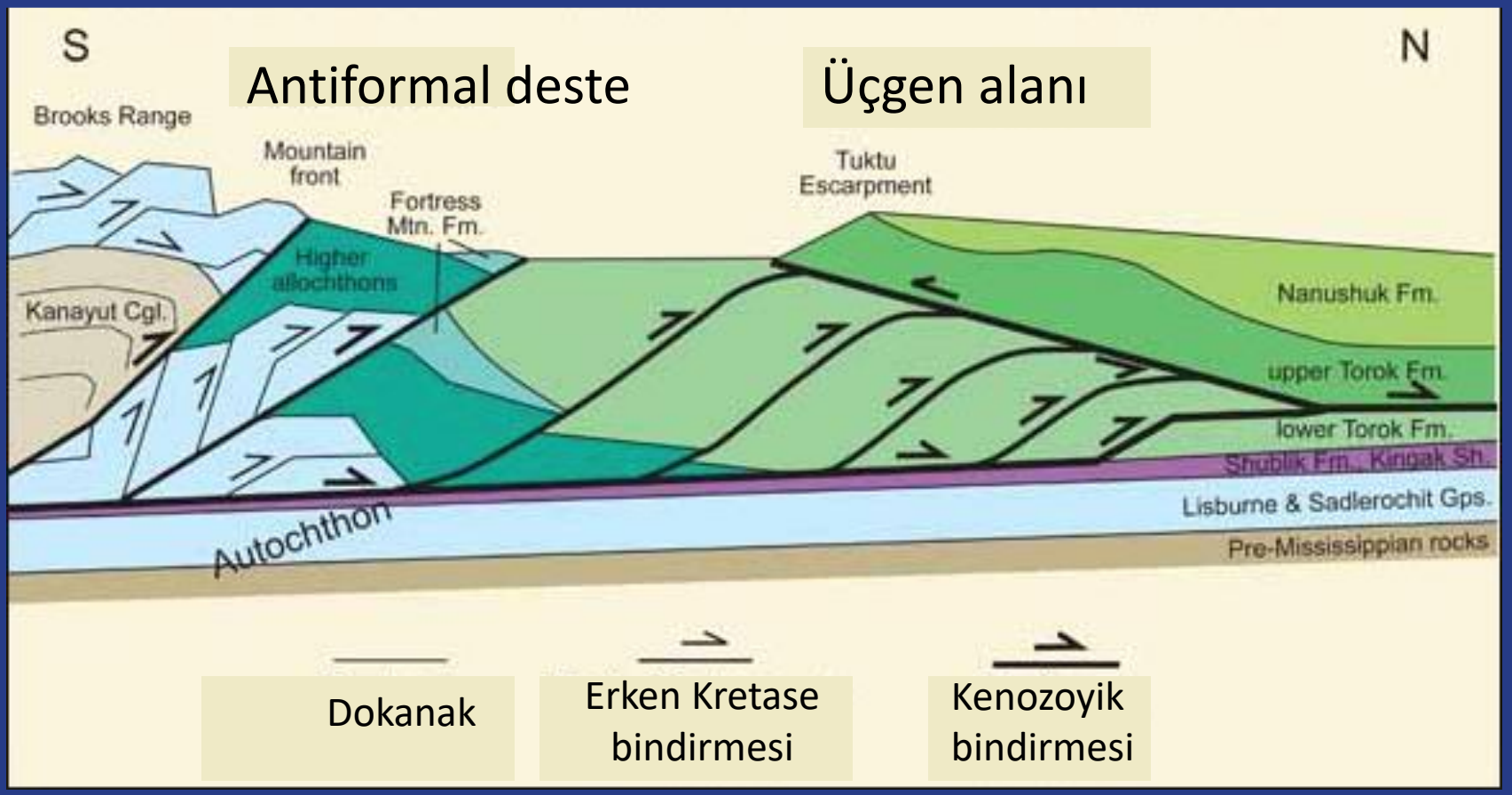



R. 16
R. 15
R. 14
CHUNGO ANTICLINE
ANCONA THRUST
STOLBERG ANTICLINE
T. 4
LINE OF CROSS-SECTION B – B'
STOP 8
BRAZEAU ANTICLINE
Goldeye Centre
NORDEGG
BIGHORN
NORTH
McCONNELL
THRUST
N. RAM
Km
0
5
10
Tersiyer
Üst Kretase
Alt Kretase, Jura, Triyas
Alt Karbonifer-Devoniyen

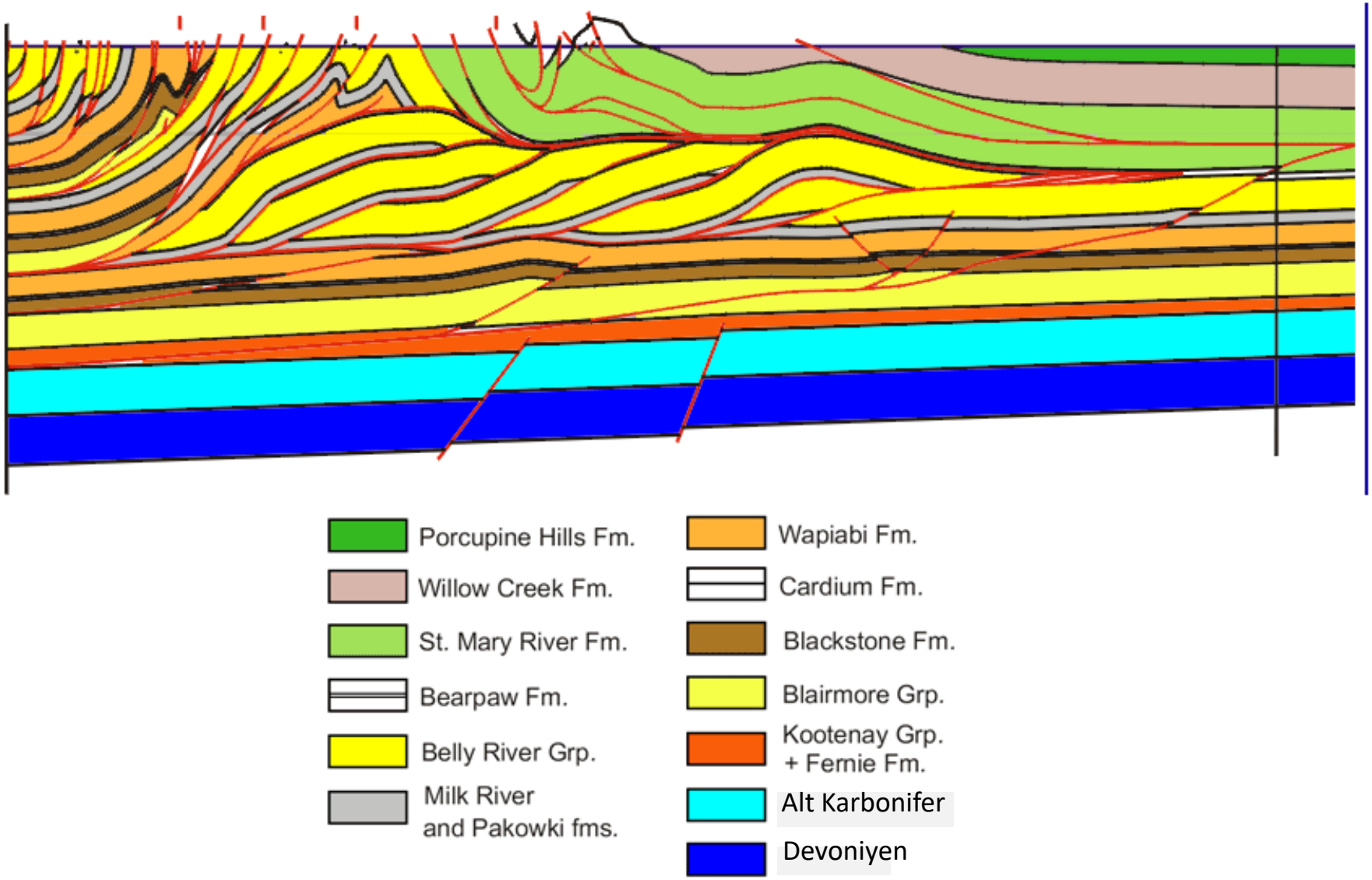
LOFF 8 long offset high intensity line
Deep basin
Triangle zone
Brazeau Thrust
Bighorn thrust
Nordegg



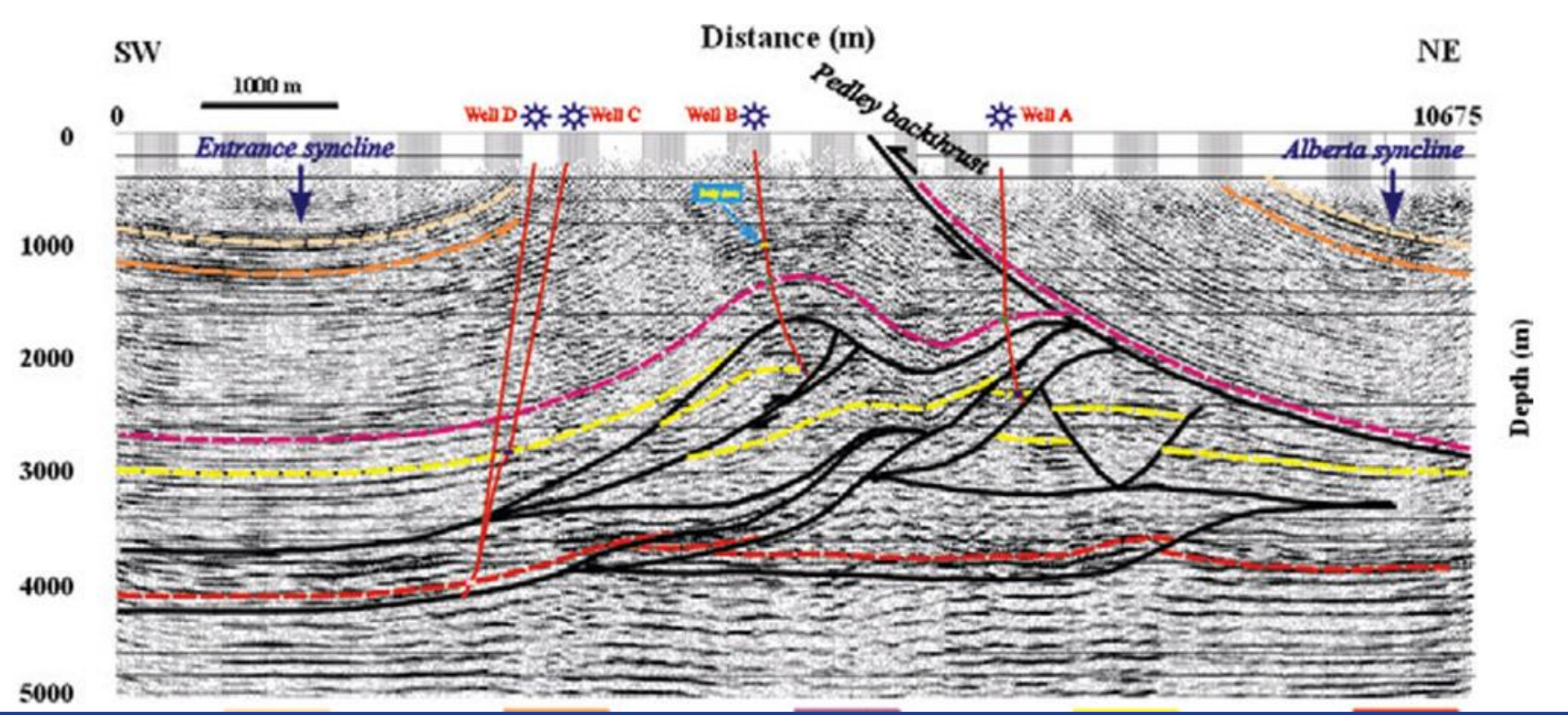
Üçgen alanlarının (triangle zones) oluşumu

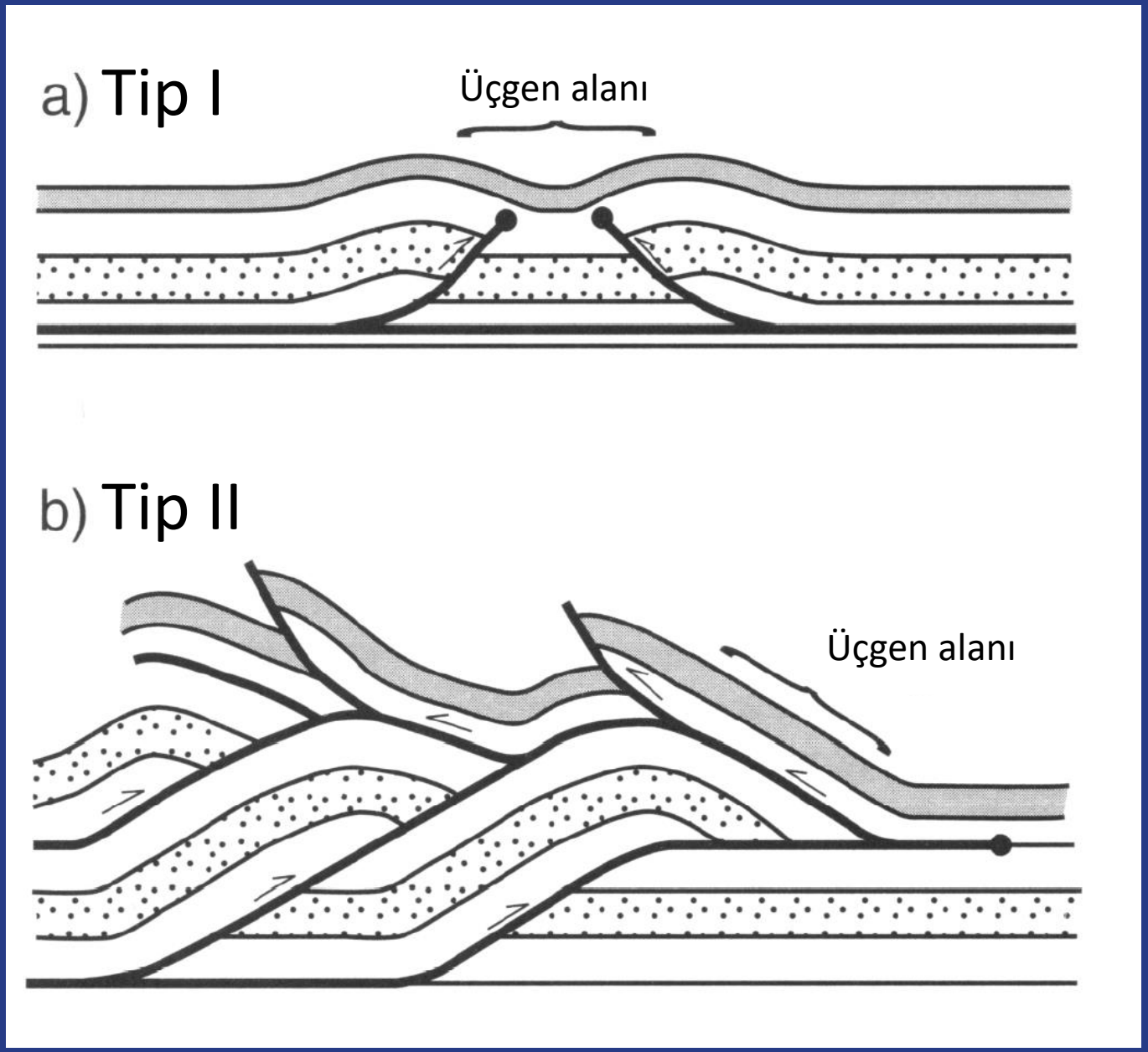


Kuzey Alaska Brooks Silsilesinde bir üçgen alanı: ABD



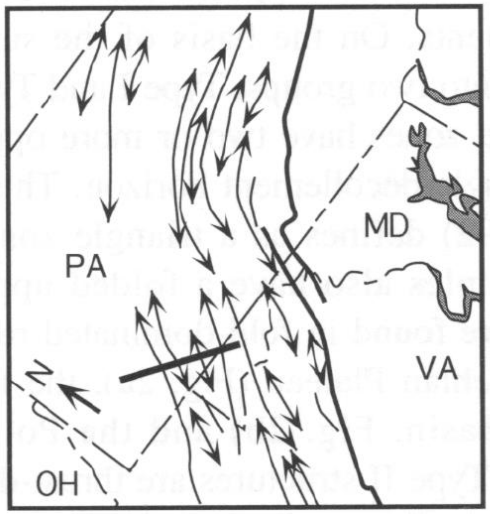
Kuzey Kanada Kayalık Dağlarında üçgen alanları

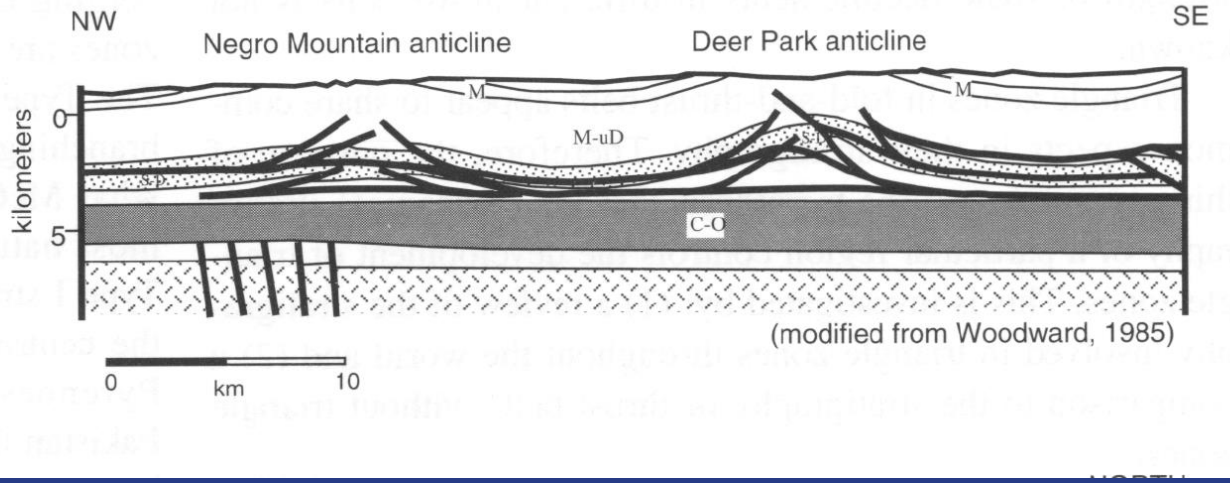

SW
Distance (m)
NE
1000 m
0
10675
Well D
Well C
Well B
Well A
Pedley backthrust
Entrance syncline
Alberta syncline
0
1000
2000
3000
4000
5000
Depth (m)



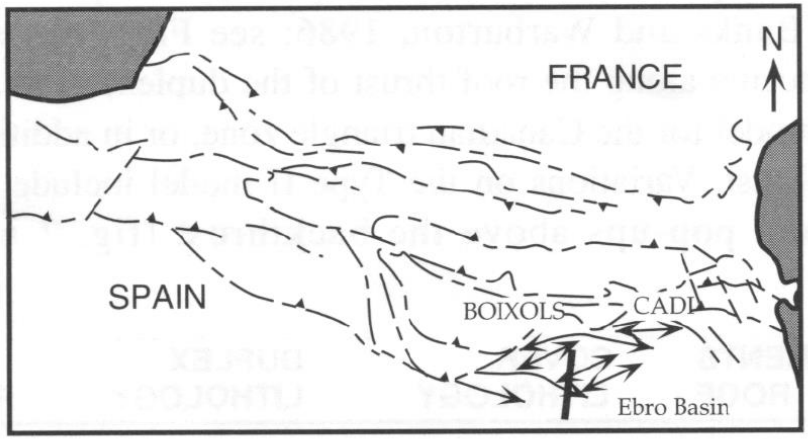
Üçgen alanlarının iki ana tipi (Couzens ve Wiltschko, 1996)

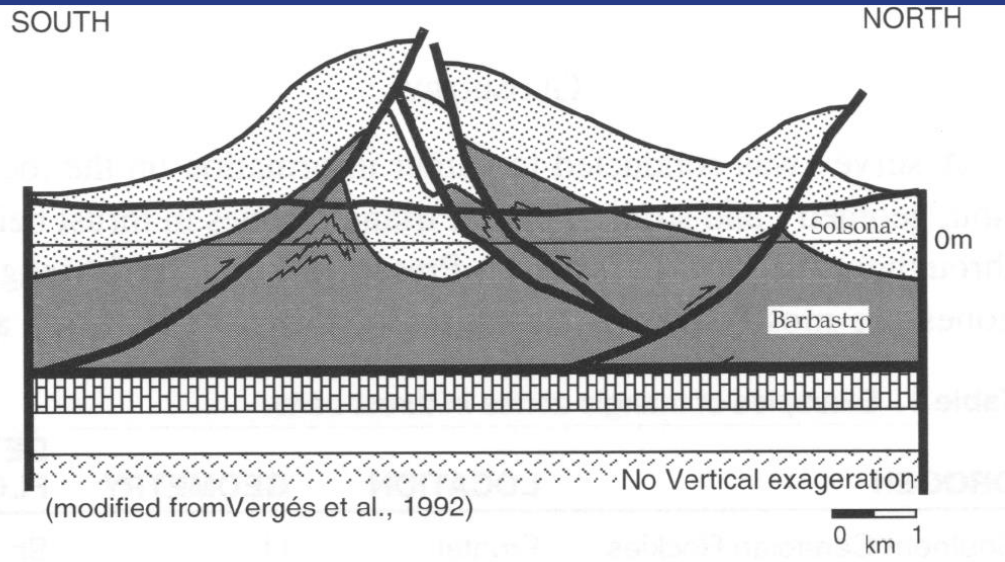
Tip I üçgen alanlarına örnekler



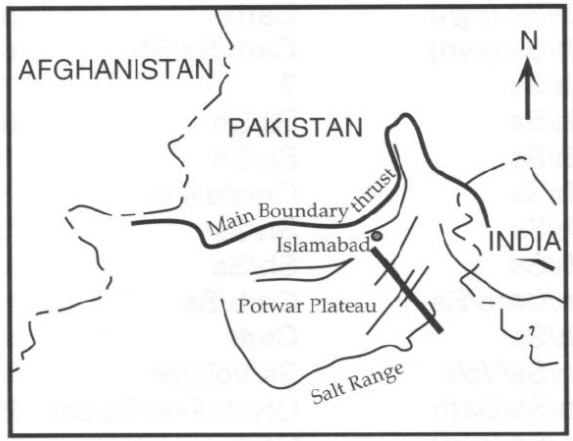


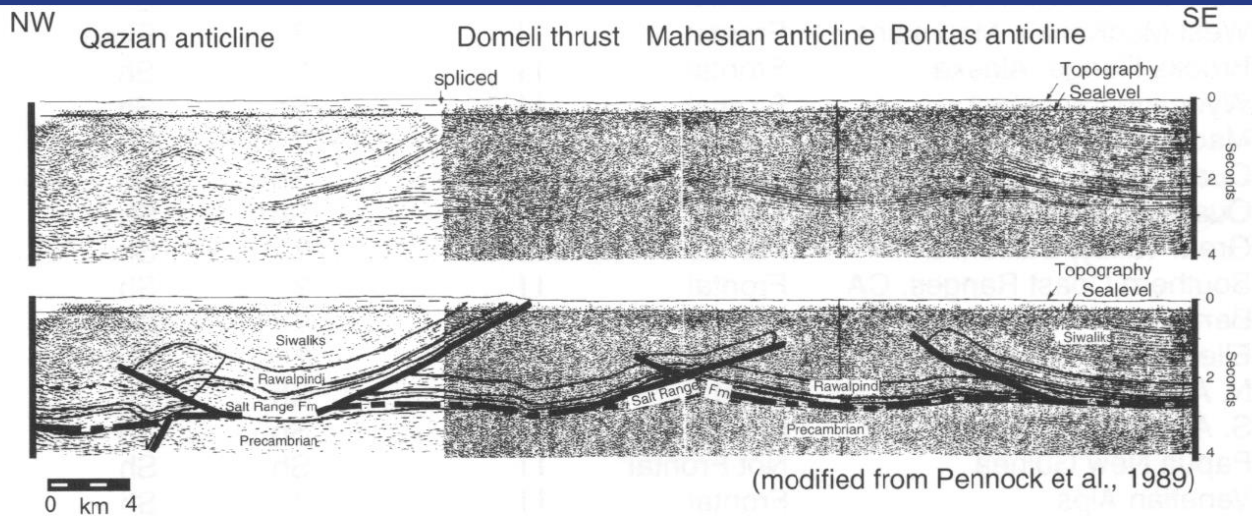
Valley and Ridge bölgesi, Güney Apalaşlar, ABD





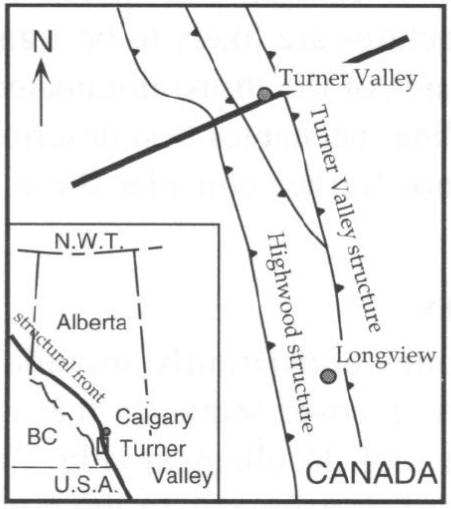
Güney Pireneler, İspanya

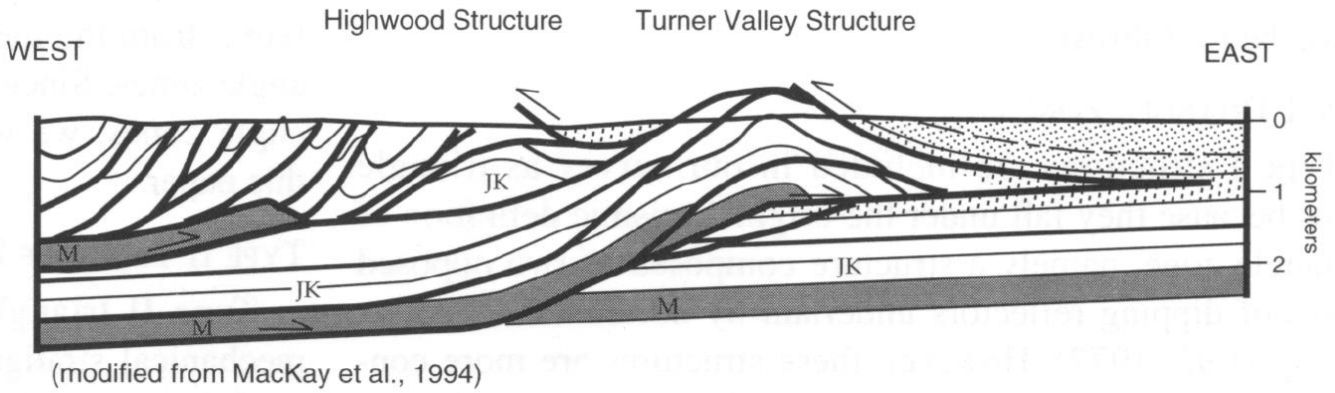




Salt Range (Tuz Silsilesi) Pakistan

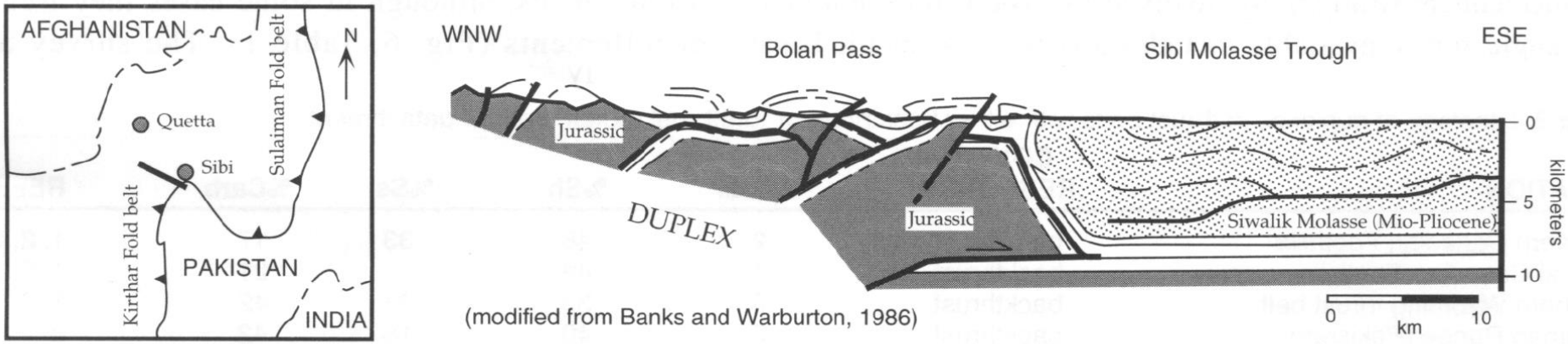
Tip II üçgen alanlarına örnekler



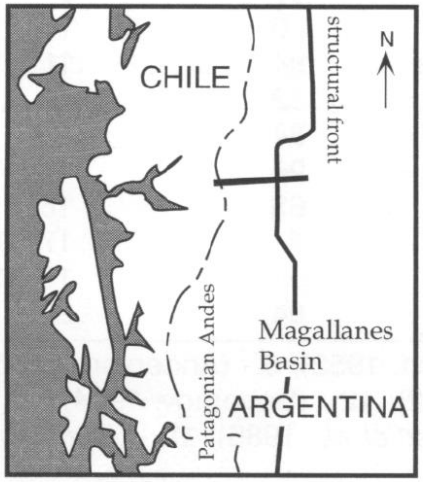


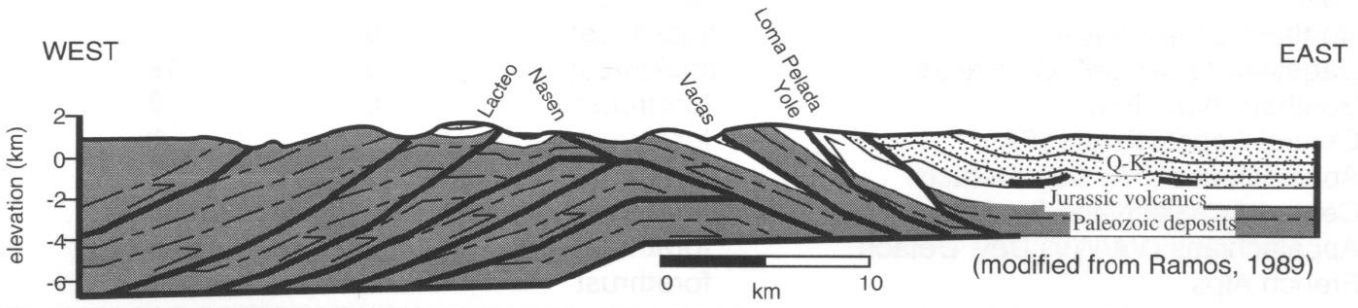
(modified from MacKay et al., 1994)

Kanada Kayalık Dağları



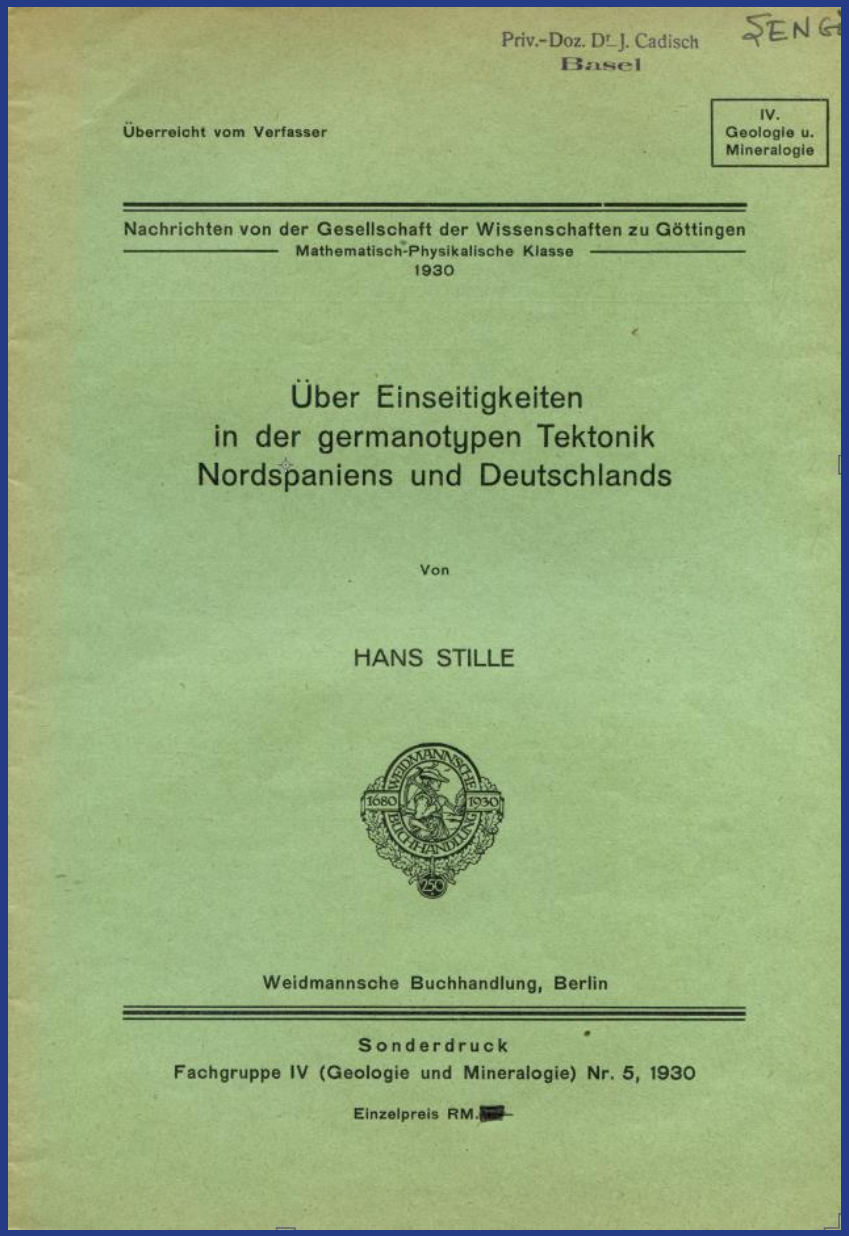
Kirtar Silsilesi, Pakistan





Güney Andlar, Arjantin

Verjans kavramı



Priv.-Doz. Dr. J. Cadisch
Basel

Überreicht vom Verfasser

IV.
Geologie u.
Mineralogie

Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen
Mathematisch-Physikalische Klasse
1930

Über Einseitigkeiten
in der germanotypen Tektonik
Nordspaniens und Deutschlands

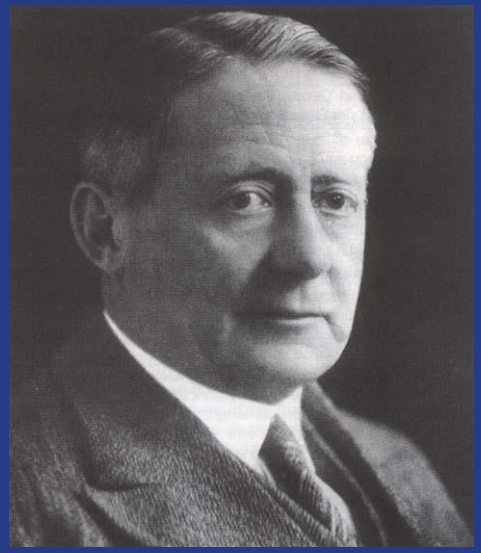
Von

HANS STILLE

Weidmannsche Buchhandlung, Berlin

Sonderdruck
Fachgruppe IV (Geologie und Mineralogie) Nr. 5, 1930

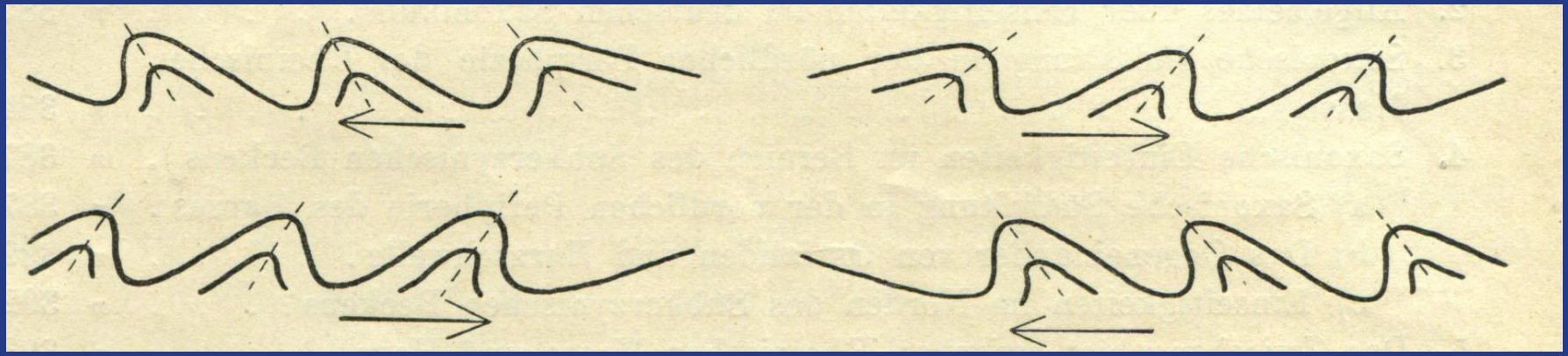
Einzelpreis RM.



Hans Stille (1876-1966)

Verjans: kıvrım devrilme yönü

(Lâtince *vergere* fiilinden: “bir şeye doğru eğilmek”)

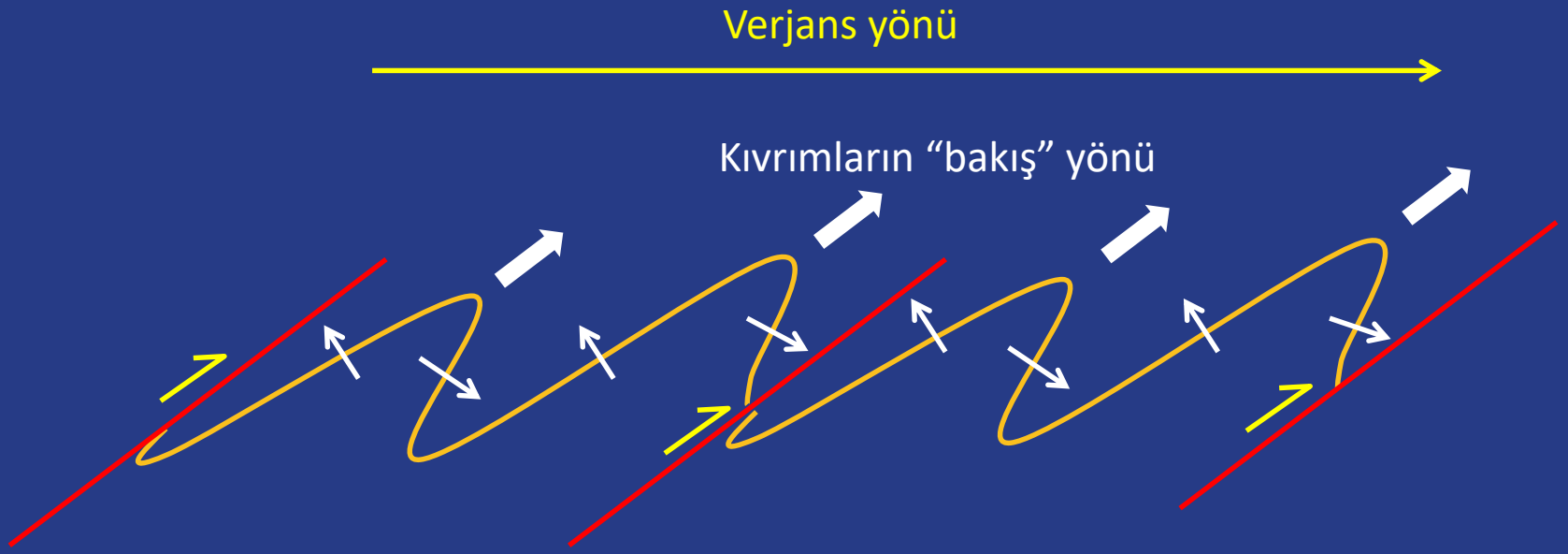


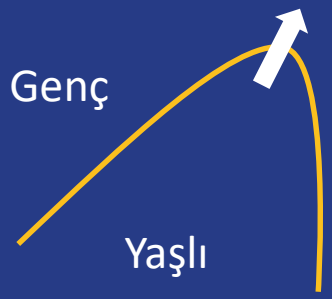
Diverjans (yukarıda) ve anti-verjans (aşağıda)

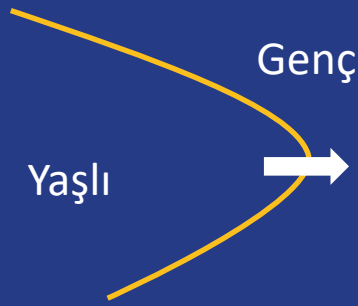
Stille, 1930’dan

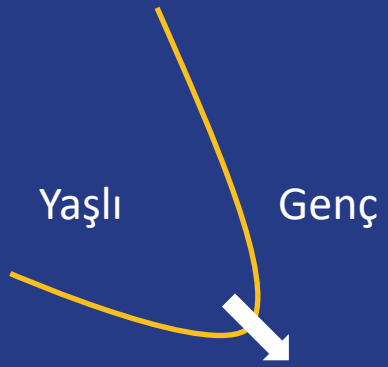
Verjansın modern tanımı:

Verjans, yamulmaya uğramış bir kayaç hacmi içerisinde kıvrım devrilme ve bindirme üst levhası hareket yönüdür.



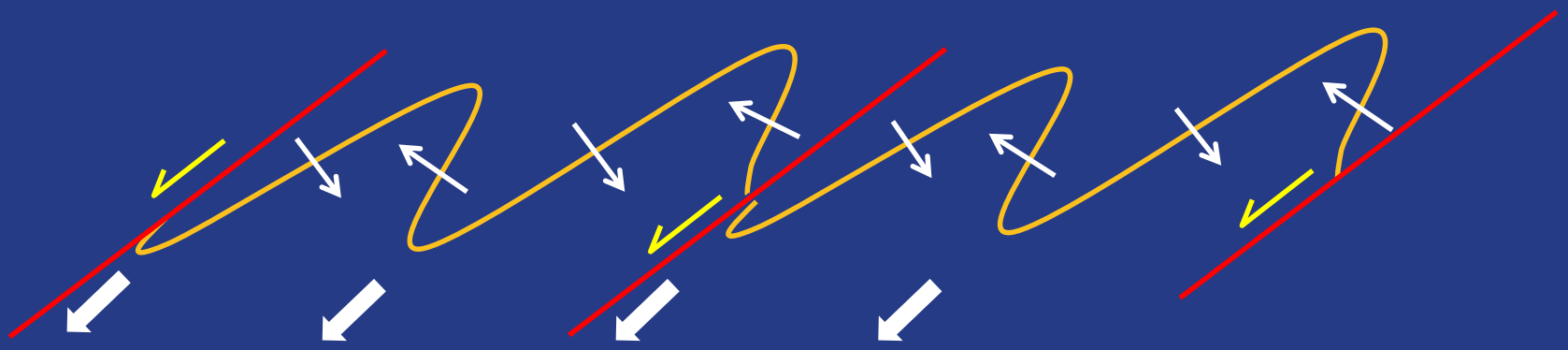




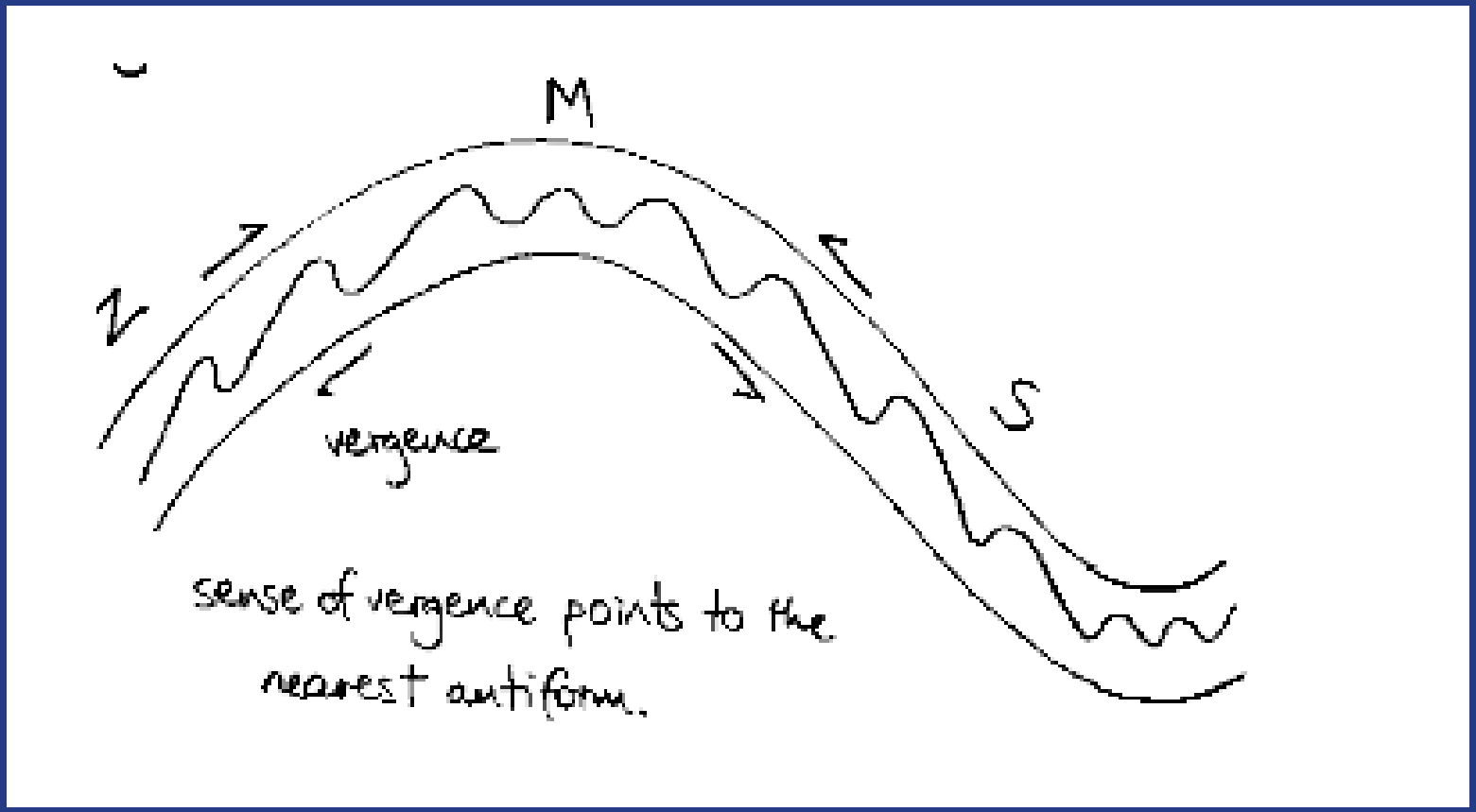


Kıvrımlarda “bakış yönü” kavramı

Verjans yönü

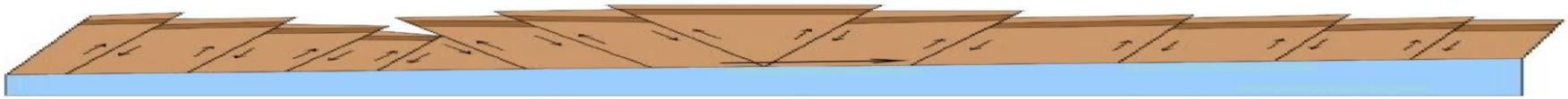


Kıvrımların “bakış” yönü

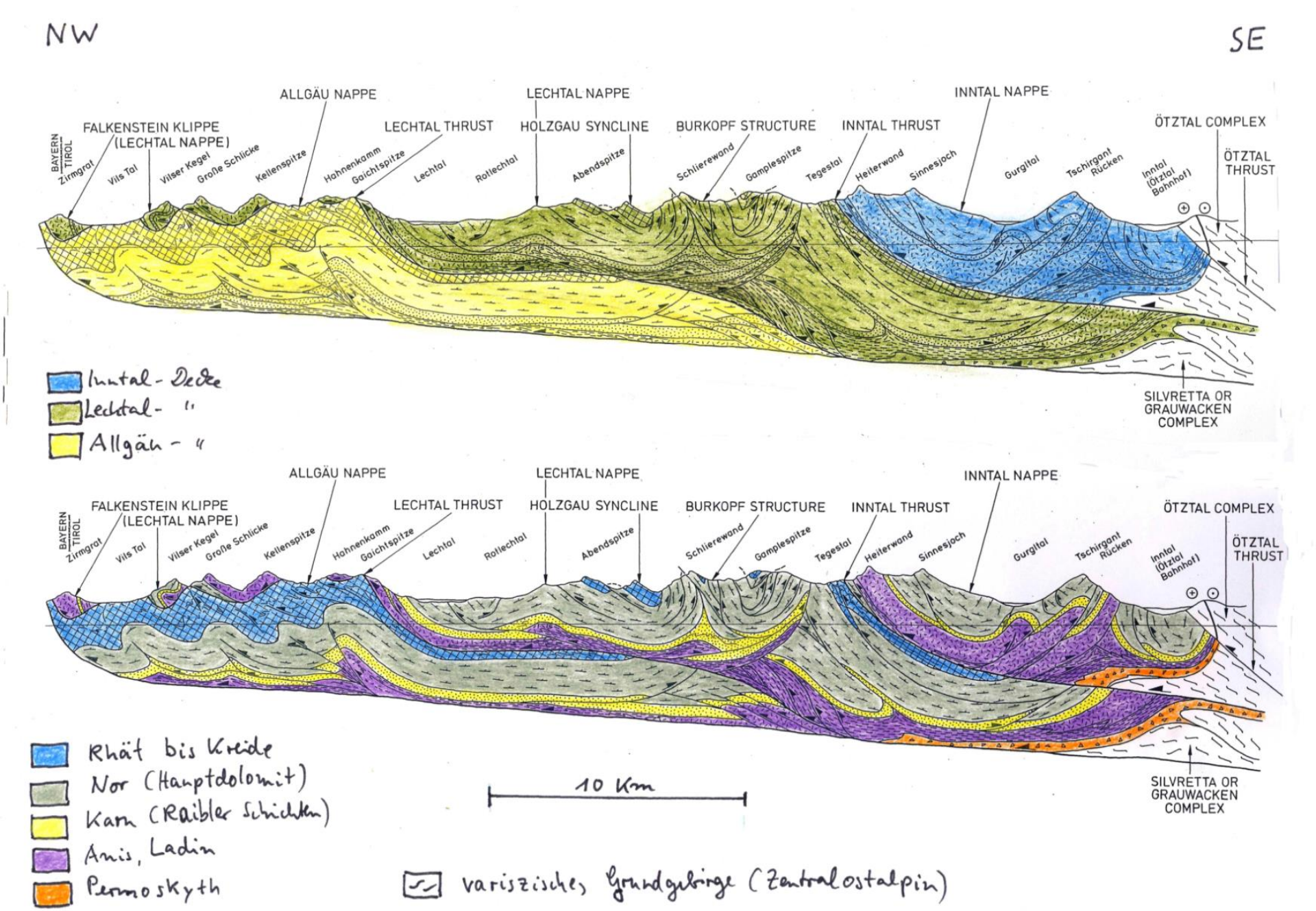


Verjans teriminin yaygın ama yanlış bir kullanımı

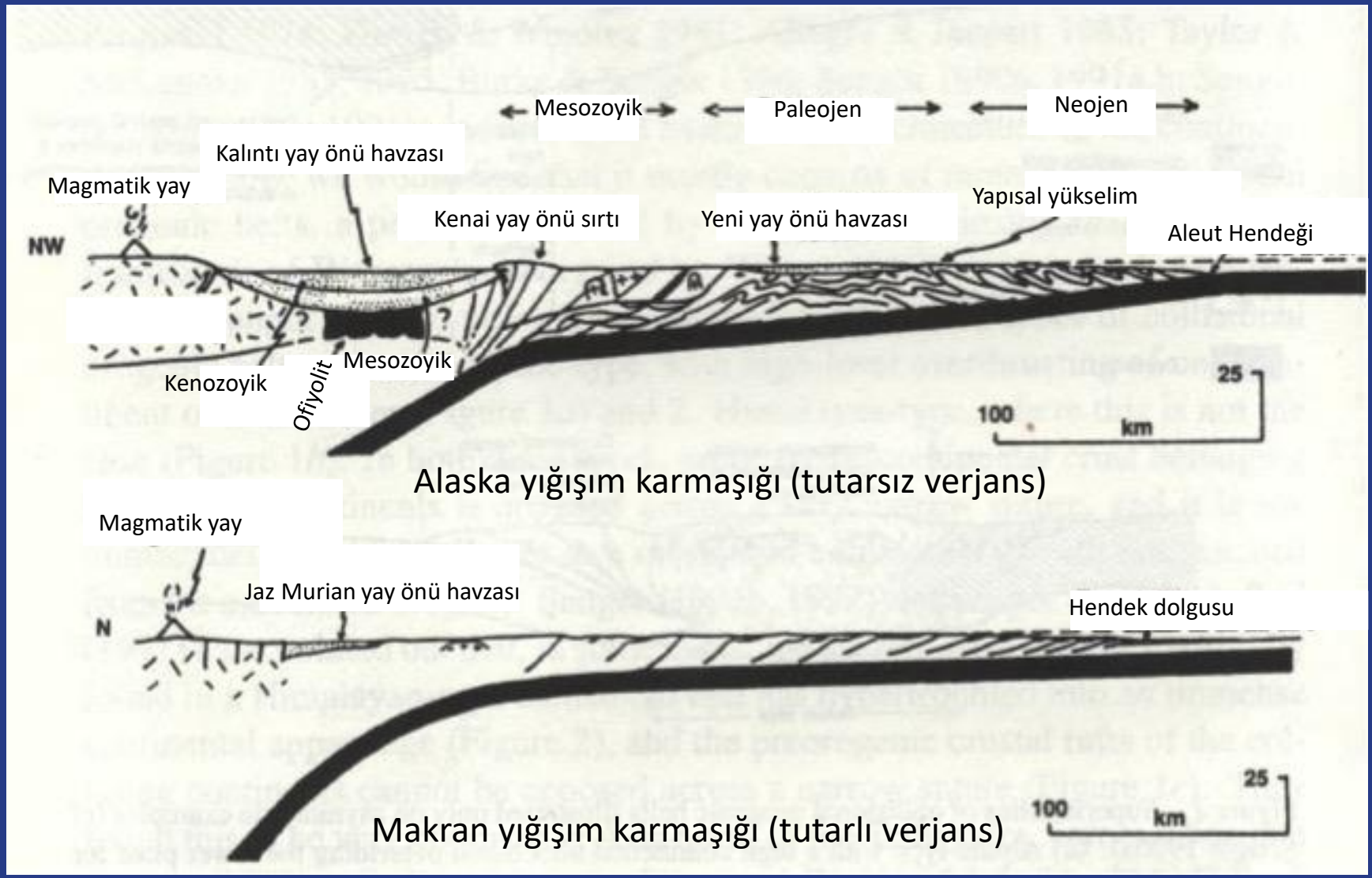
Verjans terimi tek bir kıvrımın kanatlarındaki parazitik kıvrımların devrilme yönlerini belirtmek için kullanılmamalıdır



Tutarsız verjansın kökeni



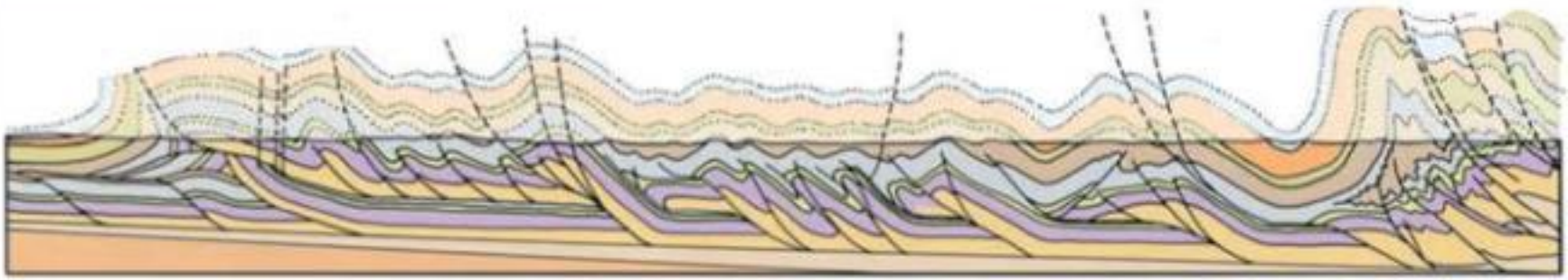
Kuzey Kalker Alplerinde tutarsız verjans: Avusturya Alpleri



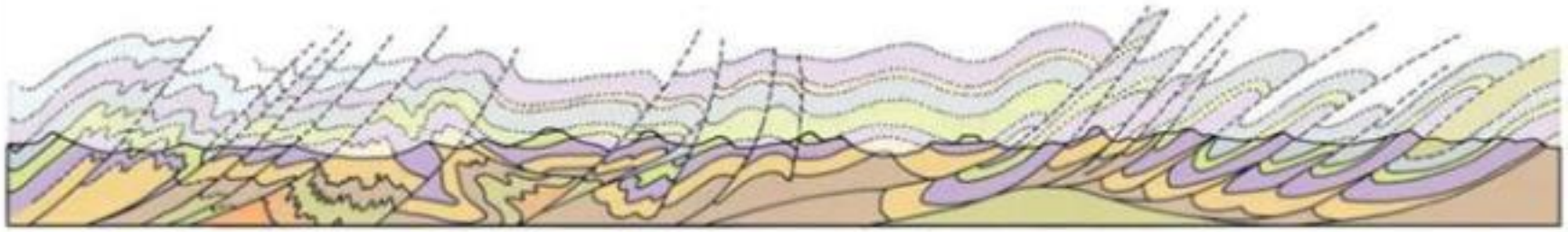
Tutarsız ve tutarlı verjans gösteren iki yığışım karmaşığı örneği: ABD ve İran

D

B



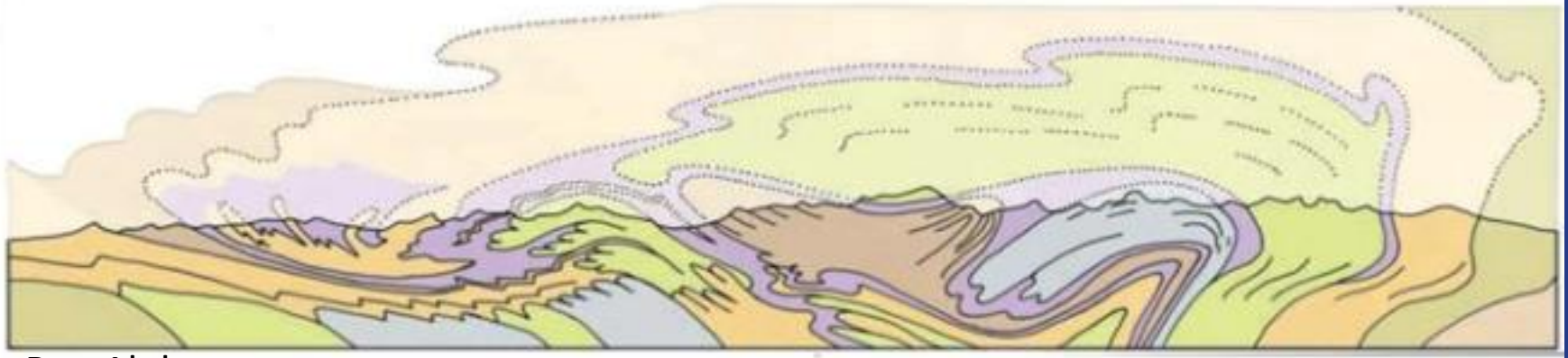
Kanada Kayalık Dağları



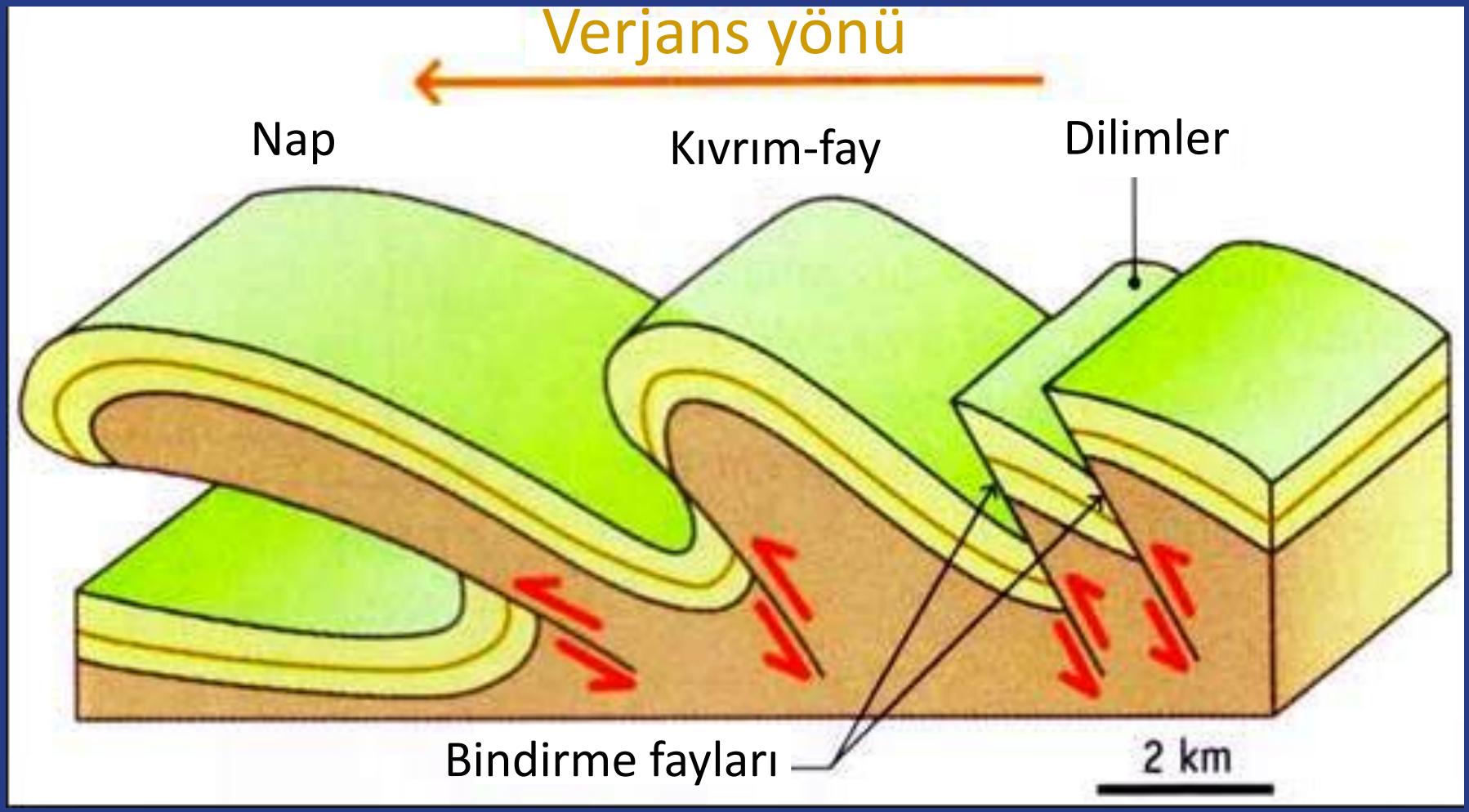
Apalaşlar

K

G



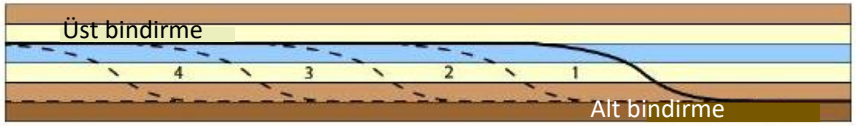
Batı Alpler

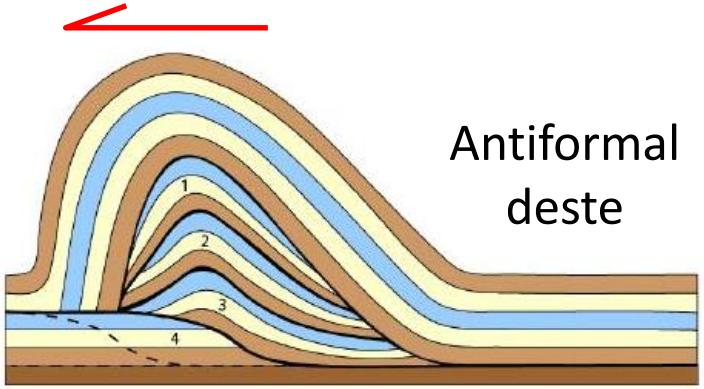


Daralma yaratan fayların çok basitleştirilmiş tayfı

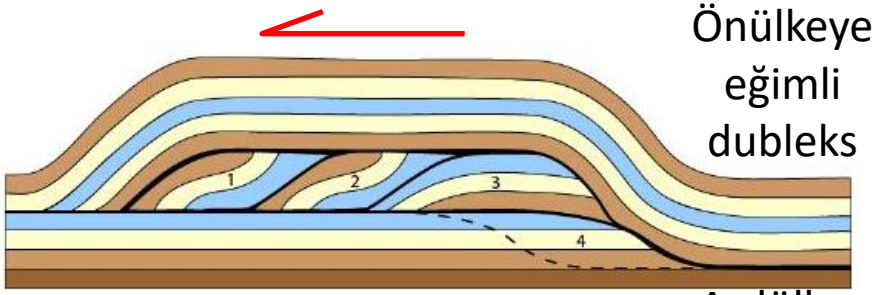
Dubleks oluşumu

Dubleks oluşmadan önceki durum

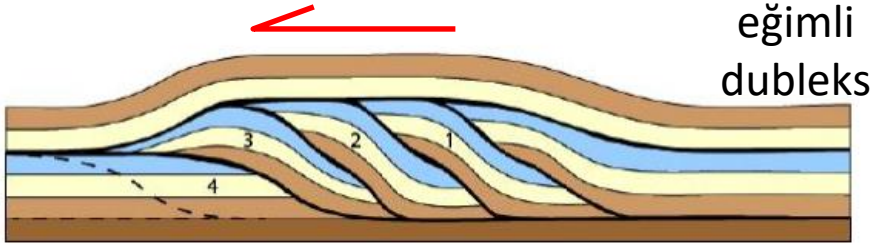




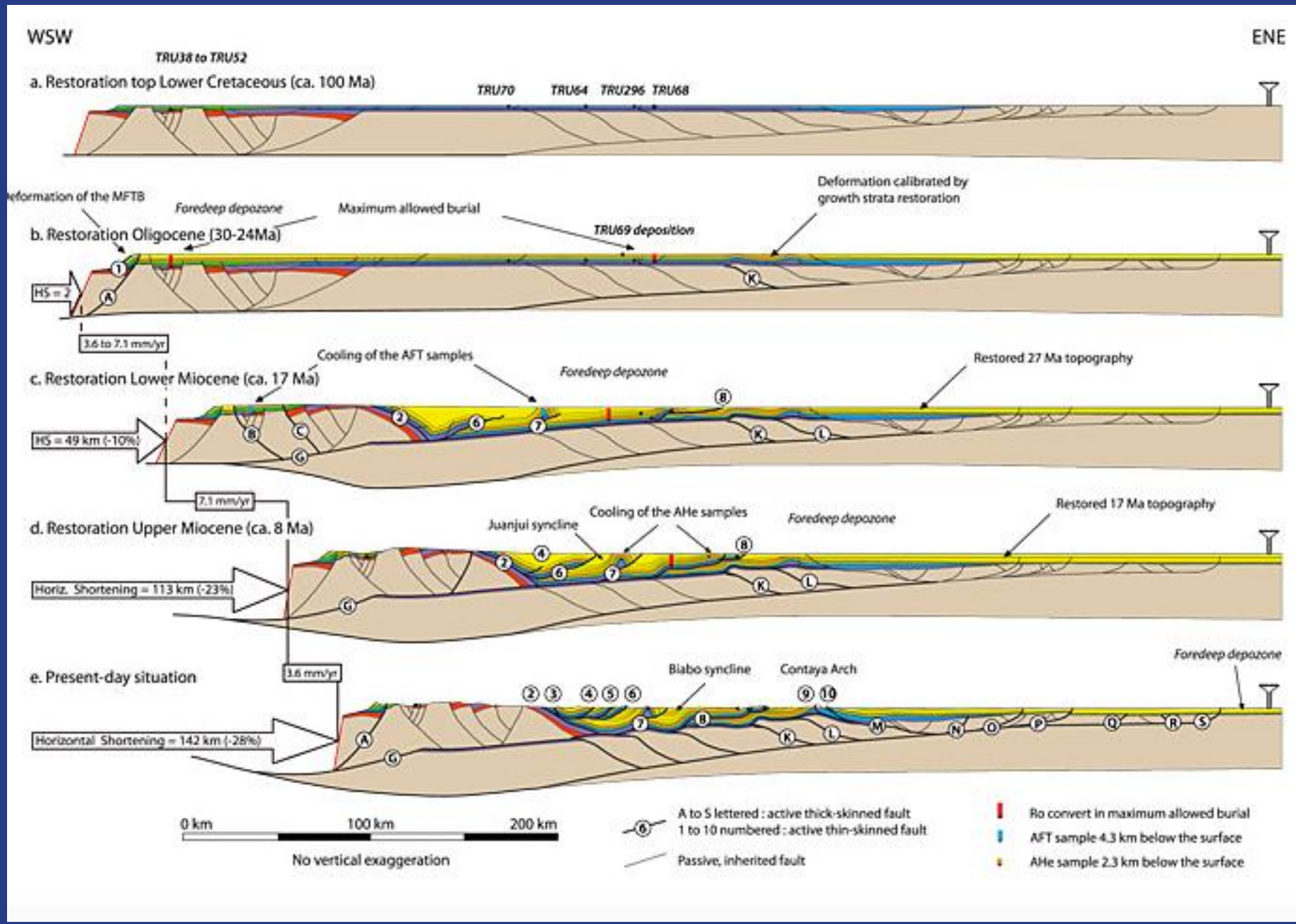
Antiformal deste

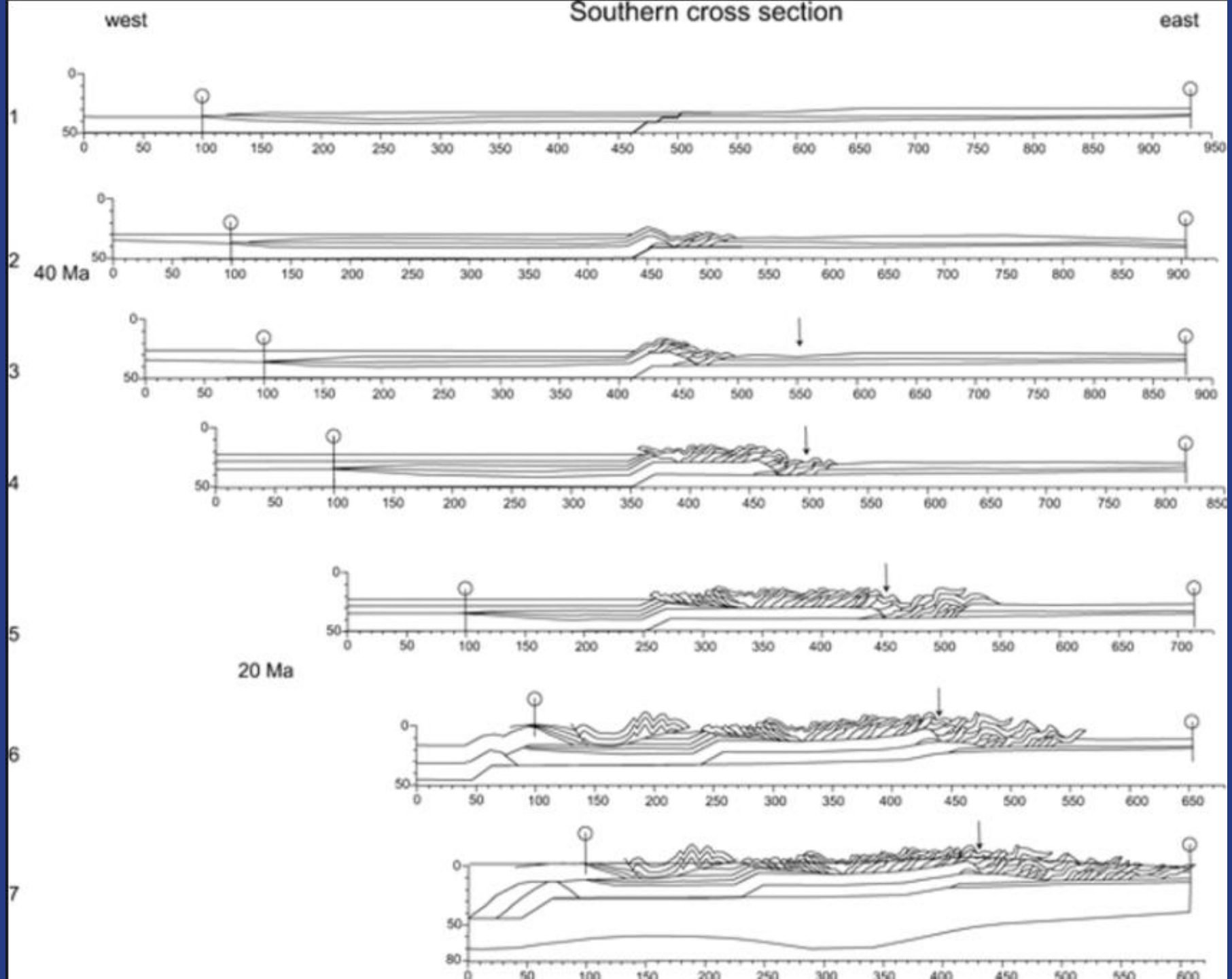


Önülkeye eğimli dubleks



Ardülkeye eğimli dubleks


WSW
ENE
TRU38 to TRU52
a. Restoration top Lower Cretaceous (ca. 100 Ma)
TRU70
TRU64
TRU296
TRU68
eformation of the MFTB
Foredeep depozone
Maximum allowed burial
TRU69 deposition
Deformation calibrated by growth strata restoration
b. Restoration Oligocene (30-24Ma)
HS = 2
3.6 to 7.1 mm/yr
Cooling of the AFT samples
Foredeep depozone
Restored 27 Ma topography
c. Restoration Lower Miocene (ca. 17 Ma)
HS = 49 km (-10%)
7.1 mm/yr
Juanjui syncline
Cooling of the AHe samples
Foredeep depozone
Restored 17 Ma topography
d. Restoration Upper Miocene (ca. 8 Ma)
Horiz. Shortening = 113 km (-23%)
3.6 mm/yr
Biabo syncline
Contaya Arch
Foredeep depozone
e. Present-day situation
Horizontal Shortening = 142 km (-28%)
0 km
100 km
200 km
No vertical exaggeration
A to S lettered : active thick-skinned fault
1 to 10 numbered : active thin-skinned fault
Passive, inherited fault
Ro convert in maximum allowed burial
AFT sample 4.3 km below the surface
AHe sample 2.3 km below the surface


Southern cross section
west
east
1
2
40 Ma
3
4
5
20 Ma
6
7